DECEMBER
1953

MECHANICAL ENGINEERING

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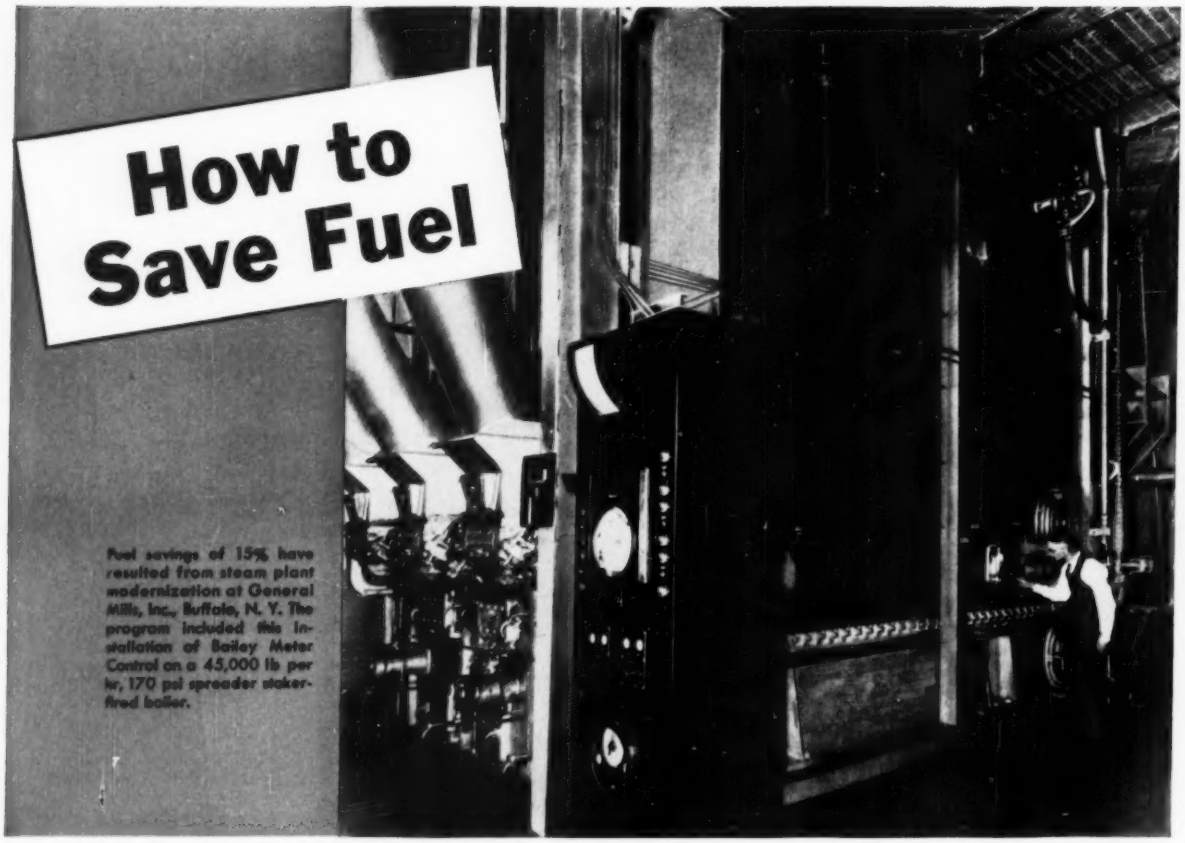
ASME International Meeting, Mexico City, Mexico, March 10-12, 1954

How to Save Fuel



Fuel savings of 15% have resulted from steam plant modernization at General Mills, Inc., Buffalo, N. Y. The program included this installation of Bailey Meter Control on a 45,000 lb per hr, 170 psi spreader stoker-fired boiler.

● The heat energy you get from a unit of fuel depends on the performance of your steam plant equipment. And that's where Bailey controls can help. With a Bailey-engineered control system you can count on a higher output of available energy per unit of fuel. Here's why:

1. Suitable Equipment

When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

2. Seasoned Engineering Experience

Your local Bailey Engineer brings you seasoned engineering experience based on thousands of successful installations involving problems in measurement, combustion, and automatic control.

3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

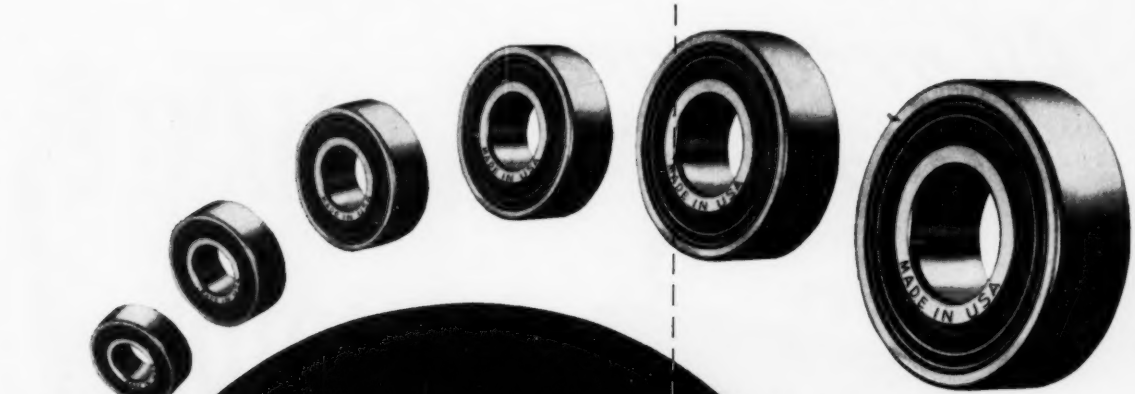
For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record. A-121-1

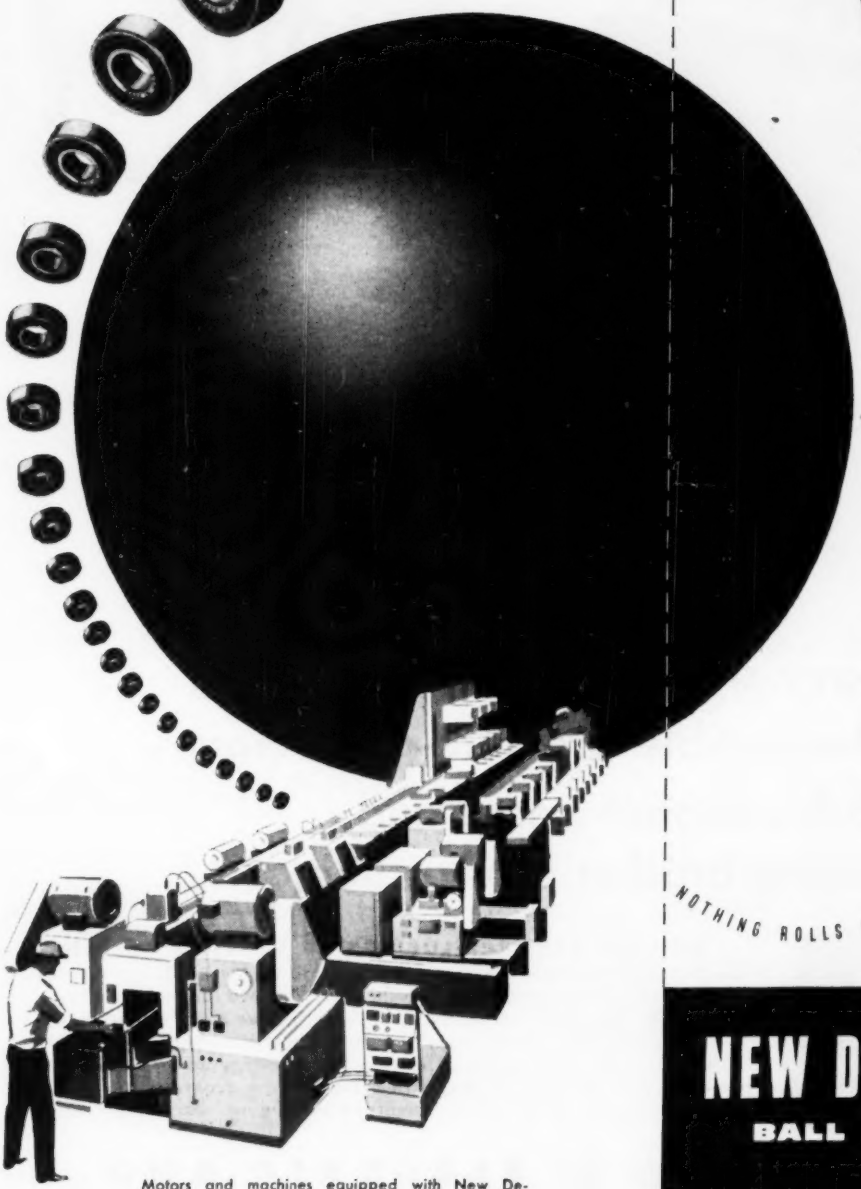
FORMULA
for Cutting
Production Costs
•
+ Bailey Design
+ Bailey Engineering
+ Bailey Service
= Greater Savings
per Fuel Dollar

BAILEY
METER COMPANY
1026 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Process Plants

BAILEY METER
Controls for—
TEMPERATURE
PRESSURE
GAS ANALYSIS
FLOW LEVEL
RATIO

SEALED-FOR-LIFE NEW DEPARTURES





Automatically Service-Free!

Compact design . . . minimum maintenance costs . . . accurate alignment . . . smooth, dependable performance . . . these are just a few of the many advantages made possible by New Departure Self-Sealed ball bearings. No wonder so many motor and machinery manufacturers are already using N-D Seal bearings. In fact, since New Departure first introduced the N-D Seal, more than 255 million have been used in hundreds of applications throughout industry.

Why not call in a New Departure engineer and find out what N-D Seals can do for *your* product?

Motors and machines equipped with New Departure Sealed ball bearings operate longer at peak efficiency with virtually no maintenance costs!

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE

BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Plants also at Meriden, Connecticut and Sandusky, Ohio

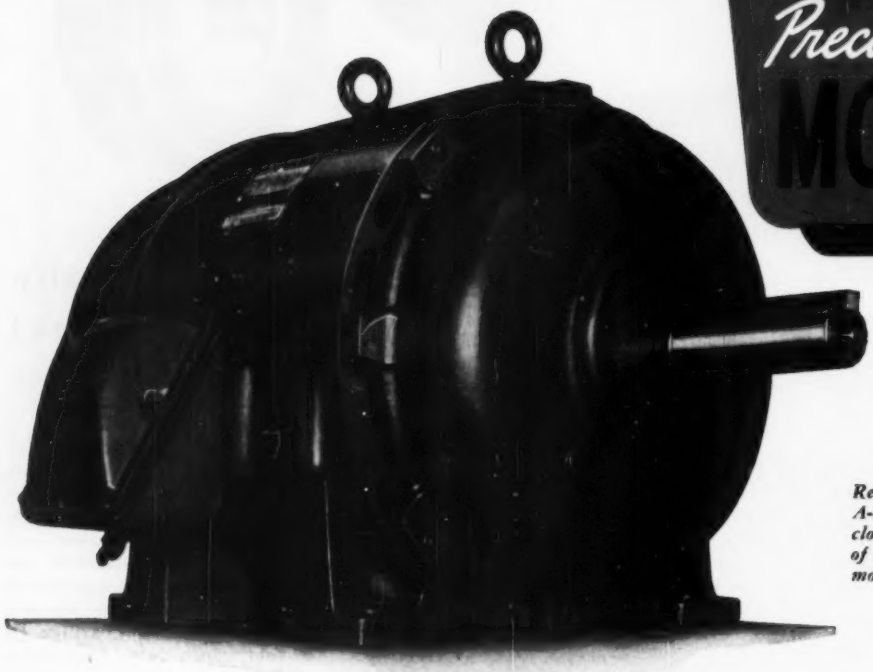
MECHANICAL ENGINEERING, December, 1953, Vol. 75, No. 12. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

For Editorial Contents See Page 949

FOR RUGGED SERVICE...

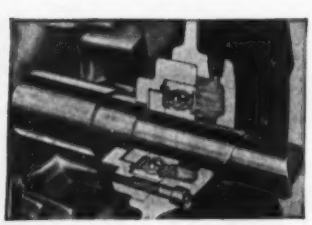
"All motors are NOT alike!"

RELIANCE
Precision-Built
MOTORS



Reliance Totally-enclosed Fan-cooled A-c. Motor. All other standard enclosures available, with wide choice of mechanical designs and special mountings. Ratings from 3/4 to 300 hp.

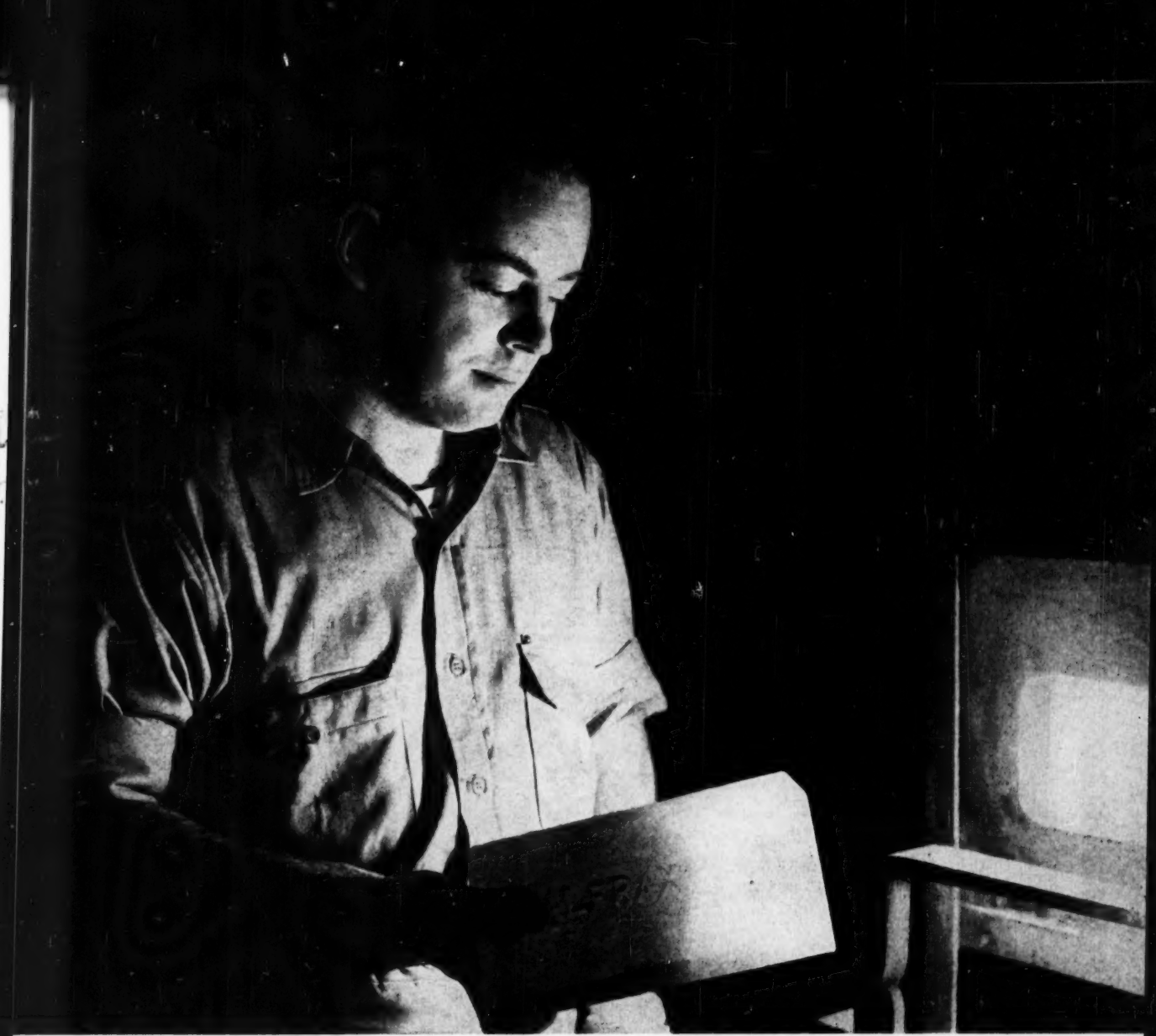
- ☆ Heavy shafts, bearing to bearing
- ☆ Indestructible pressure-cast rotors
- ☆ Shock-resistant frame and bearing-bracket construction



. . . AND THE BEST PRE-LUBRICATED BEARING DESIGN
The Reliance pre-lubricated bearing provides *four times more operating hours without re-lubrication* than any other bearing used in motors today. And—whatever your lubrication schedule—*you just can't grease 'em wrong!* To get the complete "inside story" on motor bearings, write today for Bulletin B-2201. It contains hard facts on the advantages of the Reliance pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers. B-1458 J

RELIANCE ELECTRIC AND ENGINEERING CO.

1062 Ivanhoe Road, Cleveland 10, Ohio • *Sales Representatives in Principal Cities*



Here's striking evidence of insulating ability: Though one end of this brick is incandescent—having been heated to over 2000 F—the other end is held *in the bare hand.*

"Bubble-Brick" insulates at over 3000 F

Pictured here is one of the most heat-resistant refractories available — and one of the most stable. It shows very little shrinkage, or other changes, *even at maximum burning temperatures of most fuels!* It stands higher heats (has a P.C.E. value 39-40, equivalent to 3389-3425 F), and greater loads than previously possible with low heat capacity refractories.

ALFRAX® BI refractories are literally *made of bubbles;* hollow spheres of Al_2O_3 specially bonded together. They are light in weight (a 9" straight weighs only 4.8 lbs.); have low thermal conductivity (average 7 Btu/hr, sq ft and °F/in. of thickness at 2200 F); and therefore have low heat capacity. They are also one of the most inert materials known. They are unaffected by furnace atmospheres, or combustion gases of commercial fuels.

These "bubble-brick", as they are sometimes called, are used in main linings as sidewalls, arches, doors, etc., and also for backing-up linings. They are used in many types of furnaces (e.g. powdered metallurgy furnaces, aluminum reverberatory furnaces, ceramic kilns, synthesis gas generators). The advantages are: longer refractory life, closer heat control, and a furnace that heats up quicker and needs less fuel.

ALFRAX BI aluminum oxide refractory is available as brick, special shapes, standard cements, and as a *castable* cement that you just mix with water and pour. For information about the properties of this and other unusual super refractories by CARBORUNDUM just mail this coupon.

CARBORUNDUM

Registered Trade Mark

Dept. P-123 Refractories Division
The Carborundum Company
Perth Amboy, N. J.

Please send free copy of Super Refractories booklet to:

Name _____

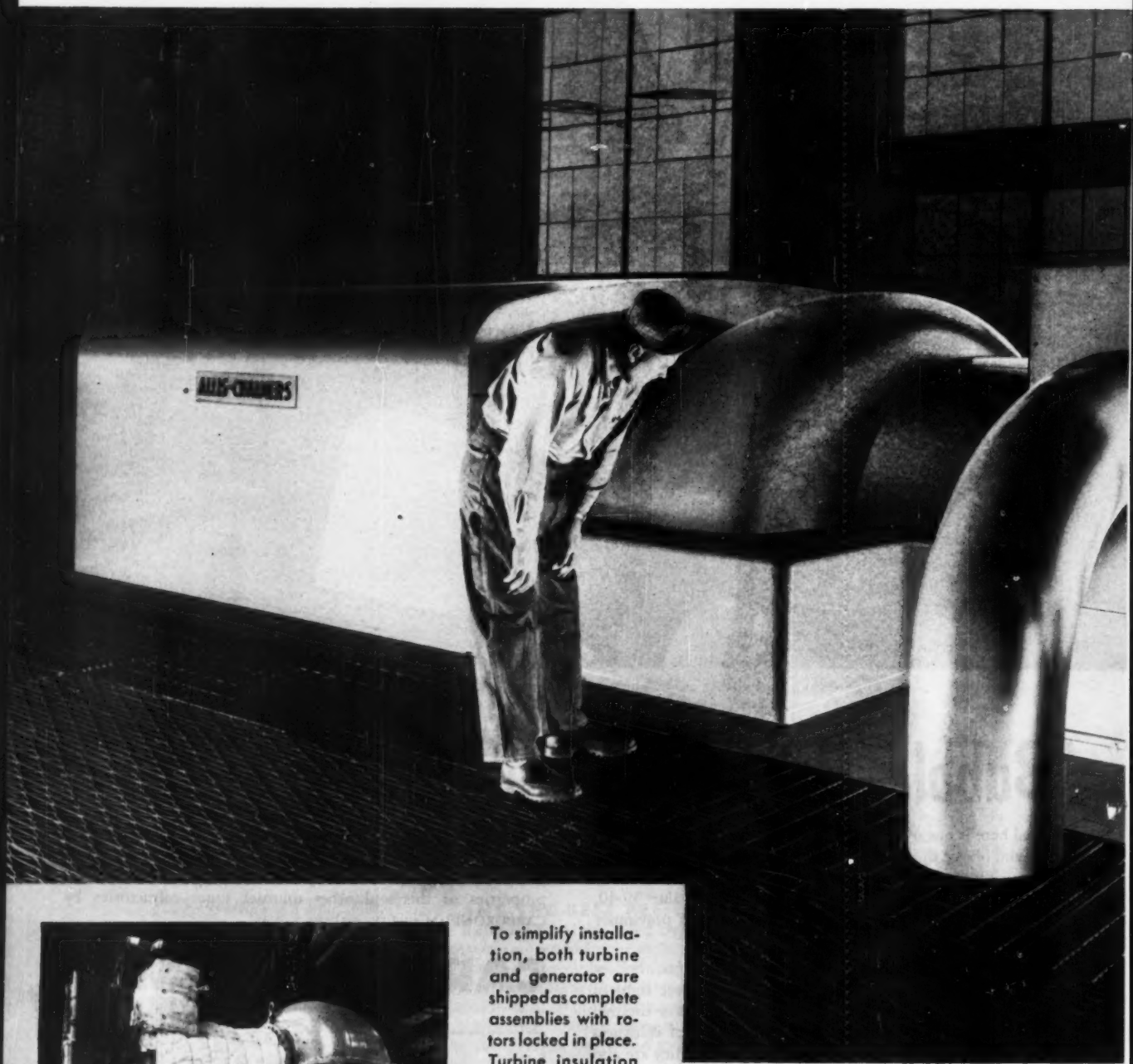
Position _____

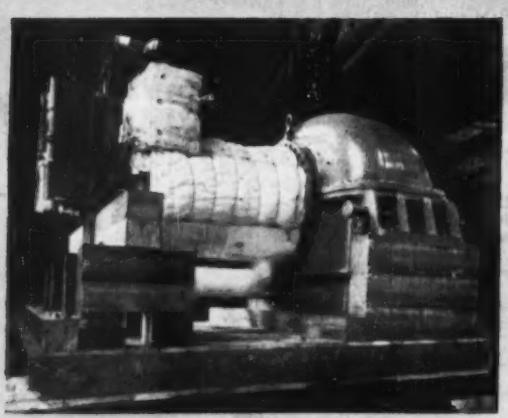
Company _____

Street _____

City _____ **Zone** _____ **State** _____

Another



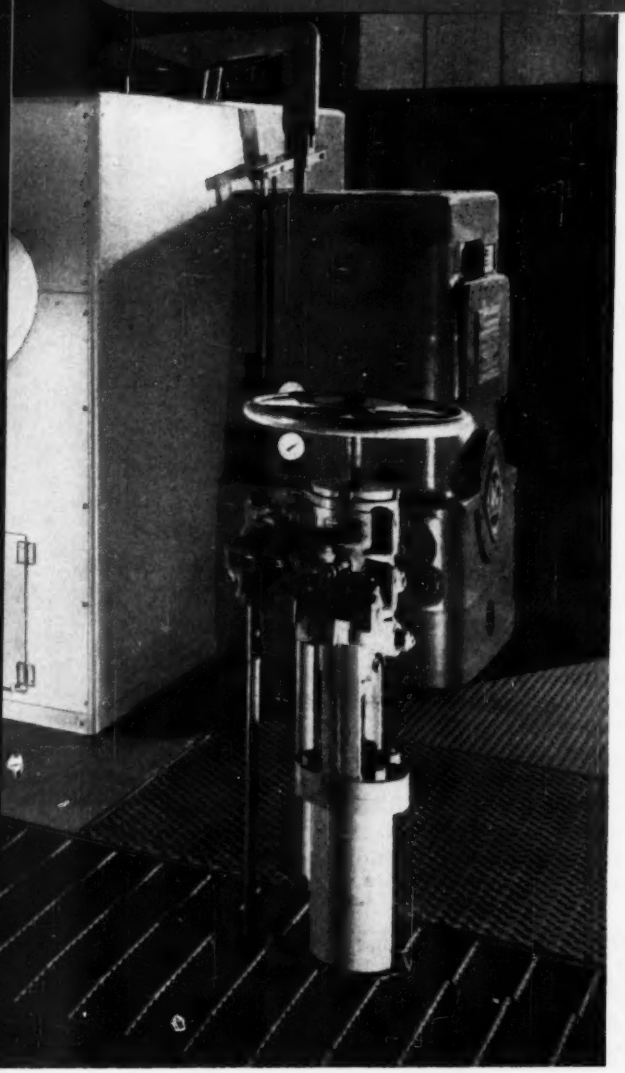


To simplify installation, both turbine and generator are shipped as complete assemblies with rotors locked in place. Turbine insulation is also applied at factory. Illustration at left shows 7500-kw turbine ready to be covered with tarpaulin before shipment.

Attractive appearance of WA-Series turbine and generator is shown above. Unit is rated 7500 kw, with steam conditions of 600 psig, 825 F, 1½ inches mercury absolute. A-C also supplied surface condenser, pumps and motors for this installation.

WA-Series

STEAM TURBINE GENERATOR UNIT



Engineered to Meet Requirements of a Modern Power Plant!

HERE'S another Allis-Chalmers WA-Series turbine generator unit with the kind of design features and performance that power producers everywhere are looking for today.

Available for condensing and non-condensing service, the up-to-date WA-Series impulse turbine design is built in sizes 2000 kw and larger in NEMA standard ratings. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and time-proved governing system.

Simplicity is Keynote

For ease of installation and maintenance, every detail has been designed to assure maximum simplicity. Three-bearing construction; above-the-floor oil piping; bracket-bearing, housing-type air-cooled generator — all result in a compact unit with simple foundation requirements. And shipment of the turbine and the generator with their rotors in place further minimizes installation costs.

Completely coordinated in design, these modern generating units are manufactured, assembled and tested in one plant under unified supervision.

For a detailed story of the WA-Series features that can help you reduce costs, ask your A-C representative for Bulletin 03B7654, or write to Allis-Chalmers, Milwaukee 1, Wis.

A-4112

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

WHAT MUST YOU HAVE

... IN POWER PIPING?

Above all other things, you must have CONFIDENCE in it.

Confidence can't be purchased—it is acquired only through complete belief in the pipe fabricator's skill, facilities, technical knowledge . . . and *experience.*

P. P. & E. has been fabricating all types of high-pressure, high-temperature piping for central stations, paper mills, process and industrial plants for almost half a century. The importance of this experience, to you, is its great value in avoiding errors of omission and commission which can result in inefficiency, damage to expensive equipment, and dangerous operating conditions.

When P. P. & E. does the job, utmost care is taken to evaluate and interpret specifications correctly, and to comply strictly with code and insurance company requirements. Highly specialized shop facilities for bending, welding, Van Stoning, machining, heat-treating, testing, and inspection have been developed, and are operated by skilled workmen under competent supervision. A trained field organization directs the installation of complete systems, extensions, or alterations to existing layouts in any part of the country.

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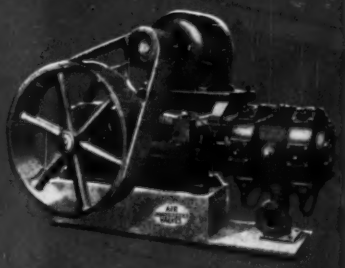
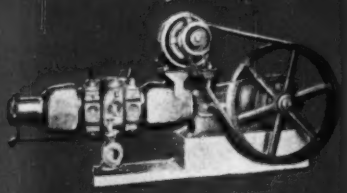
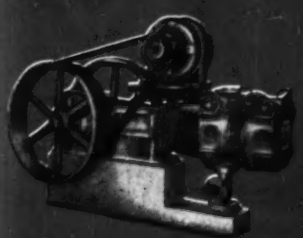


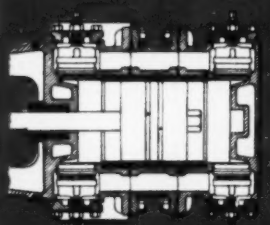
Horizontal, Single-Stage, Water-Cooled, Heavy Duty, Roller Bearing, Stationary Compressors, Class 3-AT



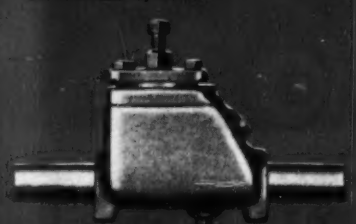
Tailored construction OILFREAIR and OILFREGAS Compressors Class 3-ATC with carbon piston rings.



OILFREAIR & OILFREGAS Compressors Class ATL with steel-backed carbon cylinder-liners.



View Through Class ATH Compressor Sectionalized Cylinder.



AIRCHEK Valve—the best discharge line check valve.

OILFREAIR®

GOOD MACHINES MAKE GOOD FRIENDS

Dependable service on parts
and helpful advice holds them.
Here at PENNSYLVANIA we build
a Complete Line of Reciprocating
Water-Cooled, Stationery Air and Gas
Compressors and Dry Vacuum Pumps
with choice of overhead or horizontal
V-Belt motor drive,
steam and steam-turbine
or engine-driven designs,
including the famous
OILFREAIR OILFREGAS
Machines, enhanced by the
New Sectionalized Cylinder*

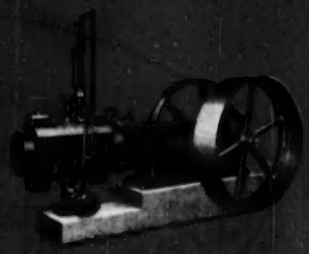
Also--Centrifugal Pumps for general service, handling clear water and aqueous solutions. Condensate and boiler feeding.

And remember: Every compressor needs an Automatic, Pulsation-Damping AIRCHEK Valve.

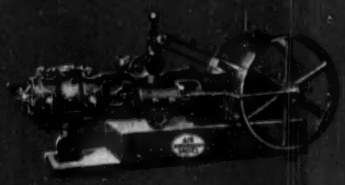
*Available in some sizes now, later in all, equipped with cylinder liners in a range of materials including nickel-alloys, iron and carbon, these Class ATH cylinders are in three pieces. They may be readily disassembled for service without disconnecting inlet or discharge air piping. Valves are in the heads adjacent to generous cooling jackets; thus, better cooling is provided where needed most.

OILFREGAS®

THRUSTFRE®



Steam Duplex Compressor Class ATL Class 3-ATS shown with by-pass regulator.



Single-Stage, Horizontal, Water-Cooled, Roller Bearing Type Steam Driven Compressor Class 4-AT

Horizontal Duplex Heavy Duty Compressors Classes 88-2, 88-3, 888-3, and 888-4

THRUSTFRE Centrifugal Pumps, 2 to 7 stages

Complete Assembly—Ring as a Unit for Low Cost

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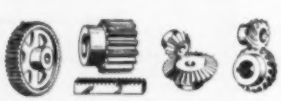
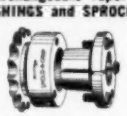


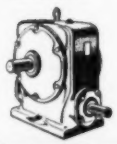
SPROCKETS and CHAIN

SHOLD-A-GRIP Interchangeable Tapered BUSHINGS and SPROCKETS



RATIOMOTORS

REDUCTORS



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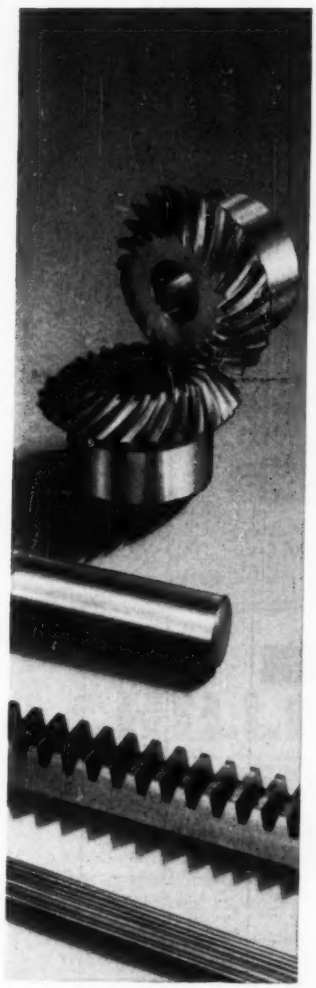

It makes sense to team up with the leader.
Choose BOSTON STANDARD STOCK gears and related drive components for your product. Here's why:

1. **LEADING SPECIALISTS** in standardized machine drive parts for 75 years.
2. **LARGEST PRODUCTION** facilities, serving 250,000 customers in all industries.
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5. **5112 STOCK ITEMS** Broadest range of standard styles and sizes.
6. **NEARBY STOCKS,** at leading supply centers . . . the nation-wide network of 92 BOSTON Gear Distributors . . . with stocks totaling $10,000,000.

These are more than advantages . . . they are *essentials* to trouble-free planning and servicing of any product assembled with standardized parts. Only BOSTON Gear offers them *all.* Compare — and you'll agree — it pays to "Design around BOSTON Gear".

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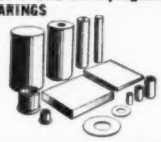
BOST-BRONZ Oil-Impregnated BEARINGS



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Industry's most valued "textbook" of drive design and maintenance . . . includes 30 pages of Engineering data.

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FOR PROMPT DELIVERIES AT FACTORY PRICES

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Look under "Gears" in the Yellow Classified Section of your Telephone Directory for the BOSTON Gear Distributor nearest you.

These Dallas, Texas building records prove WROUGHT IRON PIPE lives up to its LONGER LIFE reputation

The pipe that lasts the longest costs the least.

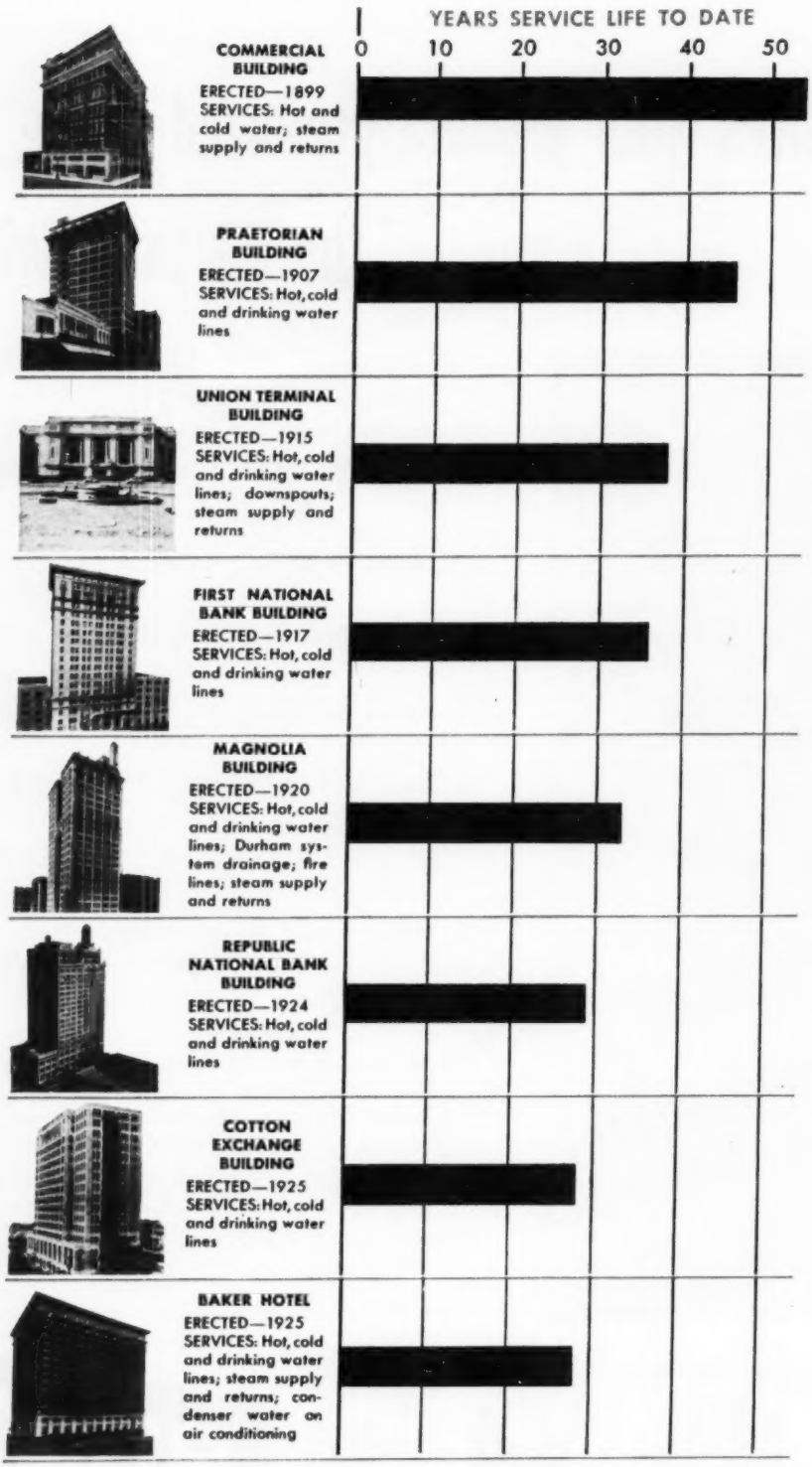
"Which piping material will last the longest?"—that's the big question which faces everyone who has the say-so on piping for corrosive services. To find the *right* answer—essential in these days of rising maintenance and replacement charges—more and more cost-conscious planners are turning to *past service records* for their yardstick to selection.

How successfully Byers Wrought Iron pipe "measures up" when engineers and architects go after this how-long-does-it-last story is reflected in the increasing use of the material in every aspect of today's modern building.

Small wonder for this confidence! Take these eight Dallas Buildings, for example. In each installation, wrought iron pipe is providing long life service at lower cost-per year. And designers everywhere are finding similar wrought iron performance records.

If you are in doubt about pipe for some corrosive service, we'll be happy to show you past wrought iron service records to fit your particular problem. Just address your letter to our Engineering Service Department . . . your request will be handled promptly.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, New York.



BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

In Connecticut, a new idea.

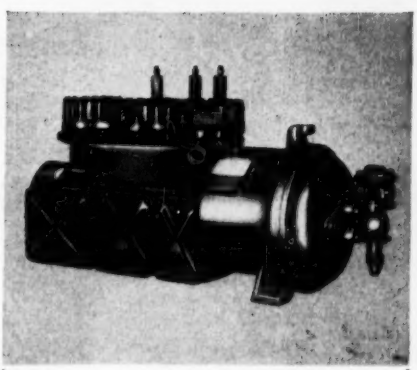
CHILLED COOLANT

BOOSTS BRASS OUTPUT

Here's an unusual application: a stock Westinghouse air conditioning compressor which speeds up rod production. First of its kind in the brass industry.

At Scovill Mfg. Co., they roll ¾" rod down to ¼", using special 12-stand mills running 24 hours a day. Our Connecticut distributor, J. P. Salmini Co., helped them improve this process. By pumping chilled coolant over the rod before it enters the rolls, they get these profit-making benefits: 1) increased output; 2) life of rolls tripled; 3) a better and more uniform finish; and 4) cleaner working conditions due to reduced oil smoke.

If your problem is product cooling—or process or comfort air conditioning of any kind—we can help you. Experienced Westinghouse distributors like J. P. Salmini Co. are located across the nation. Let one of them increase your profits with new ideas. He's listed under Air Conditioning in your classified telephone book. Westinghouse Air Conditioning Division, Hyde Park 36, Mass.



This is the compact, lightweight compressor which not only makes these production savings possible, but adds its own savings: less maintenance, longer life, peak efficiency and low operating cost. The hermetically-sealed design is the reason. No belts, pulleys, or shaft seals. It cools itself with the refrigerant it pumps!

WESTINGHOUSE AIR CONDITIONING

YOU CAN BE SURE... IF IT'S **Westinghouse**

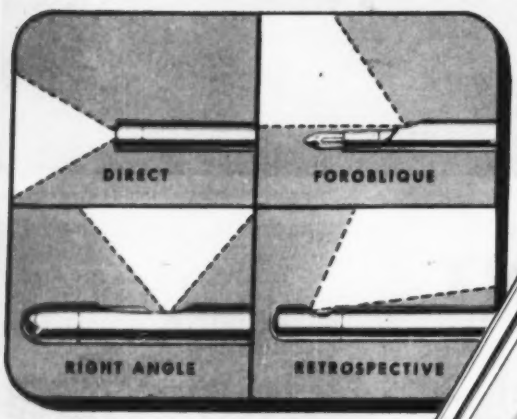
J-80324

INSPECTION OF CONFINED AREAS FACILITATED

NECESSITY OF DISMANTLING AVOIDED

TIME SAVED—MONEY SAVED

A.C.M.I. BORESCOPES



A.C.M.I. Borescopes are available in 4 angles of vision (as above)— in diameters of .120" to 4.00"— in lengths of 4" to 720". Special models for special problems.

The A.C.M.I. Borescopes permit close-up visual examination of interior areas and surfaces not otherwise visible. They save time and money, and prevent costly dismantling, by providing a practical solution to a wide variety of inspection problems.

In maintenance and inspection work, on small internal bores, machine parts or castings, to large boiler tubes, chemical plants, process equipment, or other industrial installations, an A.C.M.I. Borescope may be the answer to *your* problem.

Each Borescope is a compact, self-illuminated industrial telescope of highest quality, employing a precision optical system, that produces a flat visual field. Lens systems are fully corrected for color, spherical aberrations, and coma, with all lens surfaces coated to increase light transmission.

Write for free informational folder, or tell us your problem.

American Cystoscope Makers, Inc.

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Used in the Most Prominent Buildings

Cram & Ferguson, Architects
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POWERS

WATER TEMPERATURE CONTROL

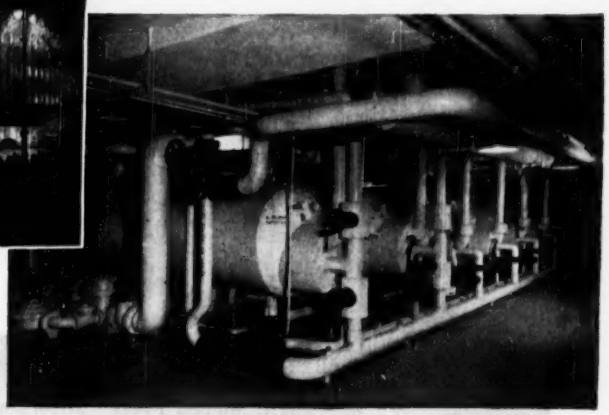
In Boston's Famous Landmark

John Hancock

MUTUAL LIFE INSURANCE COMPANY BUILDING

Water Heaters, six of which are shown below; 21 Shower Baths; 7 Dishwashers in the company cafeterias; Photostat Developing Baths for two large photostat machines . . . all are regulated by various types of POWERS Thermostatic devices especially suited for their particular use.

When problems of temperature control arise phone or write POWERS nearest office. With over 60 years' experience and a complete line of controls, some of which are shown below, we can help you find the right solution for your requirements.



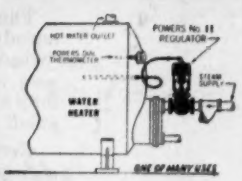
Powers ACCRITEM Regulator

Compressed air or water operated for controlling all types of water heaters, and diesel engines.

Powers FLOWRITE Valve

POWERS Thermostatic Water Mixer. Insures utmost comfort and safety in showers. Many other uses.

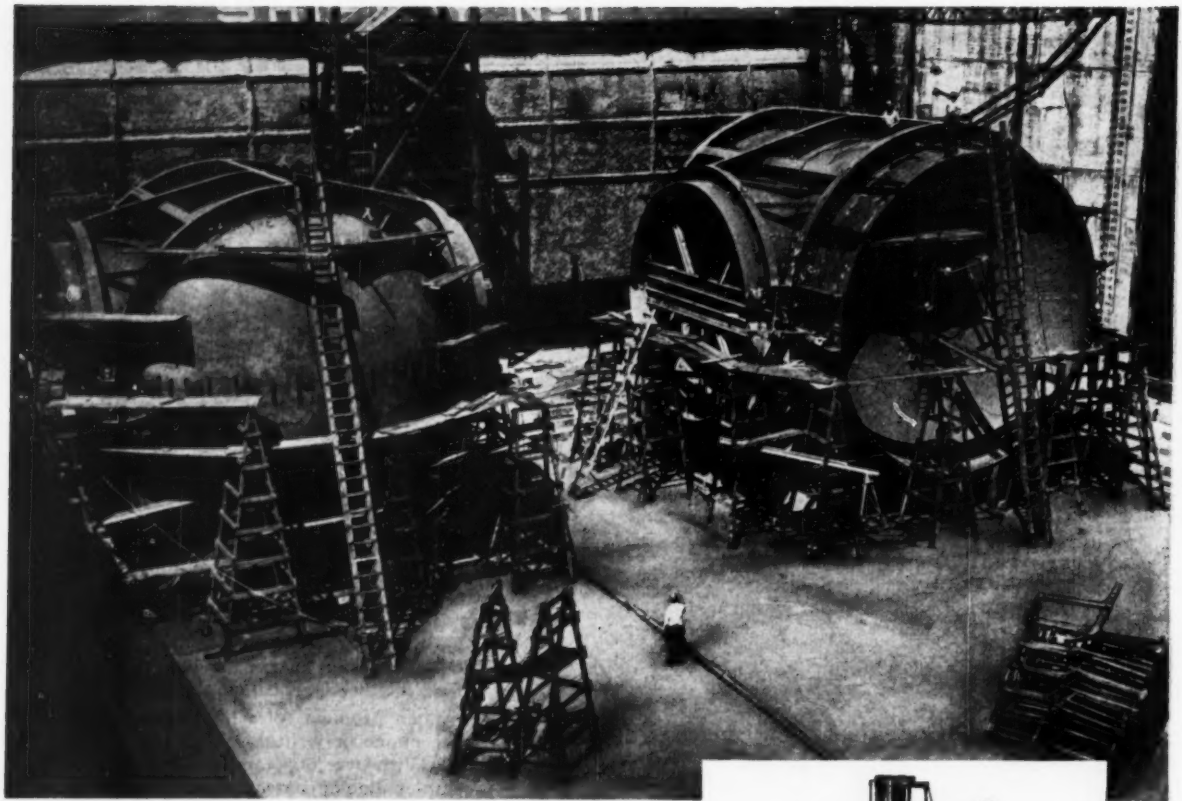
POWERS Easy to Read Dial Thermometer



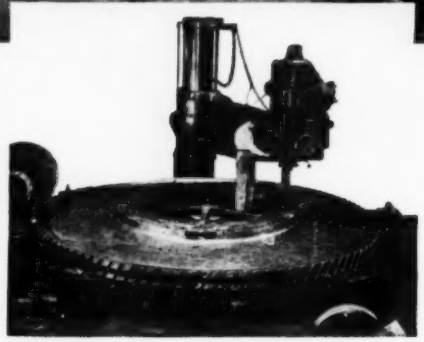
POWERS No. 11 Self-Operating Temperature Regulator for water storage heaters, hot water converters, dishwashers, fuel oil preheaters, jacket water cooling for air compressors, and diesel engines, etc.

(b29)

Established in 1891 • THE POWERS REGULATOR COMPANY • SKOKIE, ILL. • Offices in Over 50 Cities



ASSEMBLING FLOW DIVERSION VALVES of an 8-foot supersonic wind tunnel for the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics.



DRILLING A 25-TON FORGING . . . one of 11 alloy steel discs used in one of the two axial flow compressors which Newport News is constructing for the NACA's Ames laboratory.

Man-made Hurricanes

PUSH A BUTTON . . . That's all it will take to accelerate wind up to several times the speed of sound in a new supersonic wind tunnel at the Ames laboratory of the National Advisory Committee for Aeronautics, in Moffett Field, California.

The tunnel is designed to develop new aerodynamic information. Its heart is the "windmaker" . . . two axial-flow compressors which look like a giant tube 50 feet long and 24 feet in diameter, studded with small blades.

Because of the size of this unit, it is significant that the task of building these mammoth compressors was assigned to Newport News.

Newport News has also constructed two diversion valves, similar to huge plug valves, for diverting the air flow from one channel of the tunnel to another, as desired.

Large engineering and technical staffs, operating a plant with acres of brass, iron and steel foundries, five huge machine shops and other extensive fabricating facilities, make Newport News an ideal source for large equipment . . . *standard or special in design.*

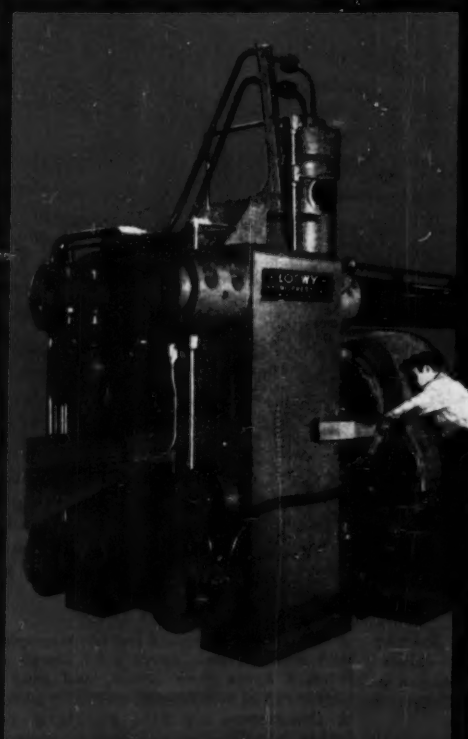
Products ranging from components of rayon spinning machines to giant 165,000 horsepower hydraulic turbines operating at Grand Coulee, reflect Newport News' high integration of skill and production facilities.

Consult us on equipment for your present or future projects. Write today for your copy of "*Facilities and Products.*"

NEWPORT NEWS SHIPBUILDING AND DRY DOCK COMPANY
Newport News, Virginia

LOEWY—HYDROPRESS
FIRST IN EXTRUSION

Recognized as the pioneer in the field
Forty years' world-wide experience in Extrusion Press design and engineering
Builder of the greatest number of Extrusion Presses — more than any other firm in this country
Supplier of the leading light metal producers, extruders and of the United States Air Force
First and outstanding in semi-automatic oil-hydraulic self-contained Extrusion Presses



Loewy-Hydropress Extrusion Presses are of the most advanced design and made for
- Easy and fast operation
- Minimum personnel and floor space
- High versatility and low maintenance costs

Loewy-Hydropress Oil-Hydraulic Self-Contained Extrusion Presses are built in capacities from 600 to 3000 tons

when you decide to make your own extrusions,
don't take chances — write or call

LOEWY HYDROPRESS INC
ENGINEERS • CONTRACTORS

Rolling Mills • Hydraulic Presses • Pipe Testing Machines • Special Pipe Mill Equipment • Accumulators • Pumps • Die Casting Machines

350M Fifth Avenue, NEW YORK 1, N. Y.

"the G-R Microflash has been instrumental in the development of our Analog-to-Digital Converter"

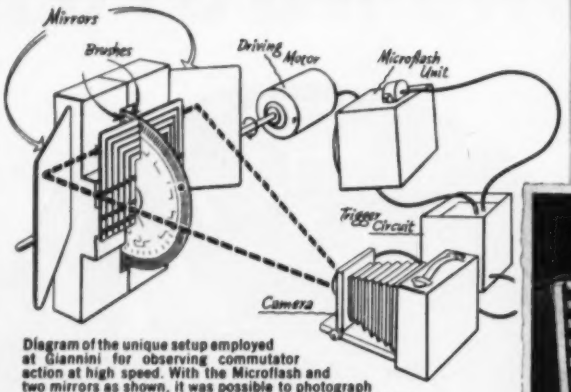
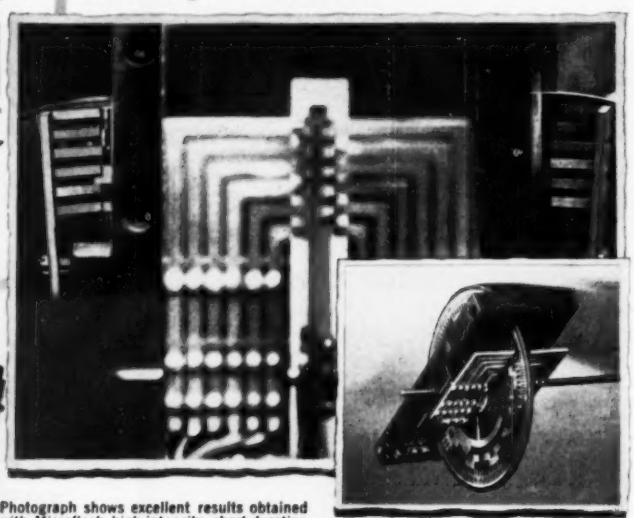


Diagram of the unique setup employed at Giannini for observing commutator action at high speed. With the Microflash and two mirrors as shown, it was possible to photograph both sides of the commutator at the same instant of time and with equal exposure.

When design engineers had to observe the brush contact points of a developmental analog to digital converter, while the commutator was actually rotating at high speed, they called for a G-R Type 1530-A Microflash. The high-intensity, short-duration flash provided by this equipment was instrumental in the development of the Giannini model 14310 Analog Position Encoder.



Photograph shows excellent results obtained with Microflash high-intensity, short-duration illumination. Back view of either side of commutator and front view are shown. Photos courtesy G. M. Giannini and Company, Inc.

Commutator of Angular Position Encoder is photo-engraved with twelve rows of conducting segments which contact twelve stationary brushes. This enables Encoder to measure angular rotation of 360 degrees with an accuracy of ±0.1%.

Type 1530-A Microflash $640

The Microflash has been successfully applied to the study of many phenomena in pure and applied science. It is widely used in studying the effects of abrasion, turbulence in liquids, and mechanical distortion at high rotational speeds.

Other applications include study of the disintegration of high-speed rotors, investigation of projectile flight and impact, and experimentation dealing with the propagation of fractures in various materials. In mechanical design, the Microflash is an indispensable tool for studying the action of springs, valves, cams, cranks, bearings and other parts moving at high speeds.

★ *G-R Type 1530-A Microflash provides an intense white light for single-flash photography of very rapidly moving objects — flash intensity is 26,000,000 beam candles — duration is only 2 millionths of a second*

★ *Power supply and trigger circuits are assembled in one metal case, lamp is in another — two sections lock together for complete protection of all controls and ease in transportation*

★ *Panel pushbutton initiates flash — alternative is to have flash tripped by noise or pressure wave associated with the action to be photographed; microphone and built-in amplifier are provided for such use*

★ *Additional jack is available for flashing from any simple external contactor — photoelectric cells, wire breaking under tension or impact, and many other easily-built devices will trip flash to suit the application*

★ *Conventional camera equipment is used*

★ *Accessories supplied include microphone with cable, tripod, spare pilot lamps and fuses, 2 spare flash lamps, and plug for connection to external-contactor trip jack*

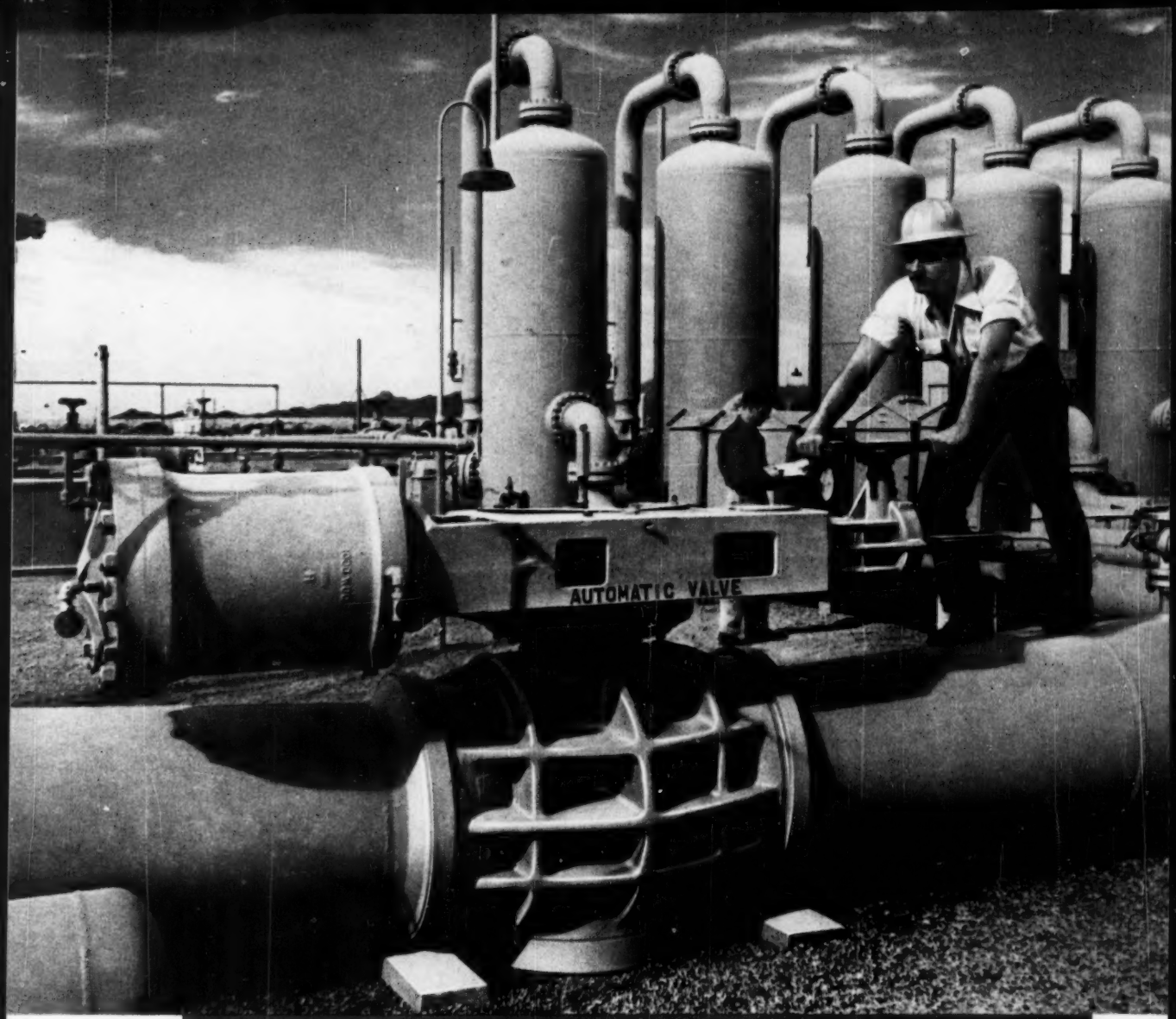
★ *Dimensions are 24⅛ x 13¼ x 11¾ inches, overall — net weight is 72 pounds*

★ *Price:* **$640.00**

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.

Admittance Meters ☆ Coaxial Elements ☆ Decade Capacitors
Decade Inductors ☆ Decade Resistors ☆ Distortion Meters
Frequency Meters ☆ Frequency Standards ☆ Geiger Counters
Impedance Bridges ☆ Modulation Meters ☆ Oscillators
Variacs ☆ Light Meters ☆ Megohmmeters ☆ Motor Controls
Noise Meters ☆ Null Detectors ☆ Precision Capacitors
Pulse Generators ☆ Signal Generators ☆ Vibration Meters ☆ Stroboscopes ☆ Wave Filters
U-H-F Measuring Equipment ☆ V-T Voltmeters ☆ Wave Analyzers ☆ Polariscopes



Lubricated INSURANCE POLICY

Ever hear of a lubricated insurance policy?

That's really what you're buying when you install power operated Nordstrom valves. You're buying *Prevention* and *Control*.

Prevention, because in a Nordstrom protective lubricant seals tighter than any other method, yet makes a sliding contact surface for instant easy operation on a quarter turn.

Control, because Nordstrom valves can be equipped for electric, hydraulic or pneumatic operation, with automatic, manual or remote control.
Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built Nordstrom Valves

Lubricant-Sealed for Positive Shut-Off

Another ROCKWELL Product

Lubricant makes a valve easier to operate, just as it will nearly any mechanical device. But that's far from its only function in a

NORDSTROM....

A system of internal grooves deposits a seal of lubricant, under pressure, around each port to prevent both internal and external leakage.

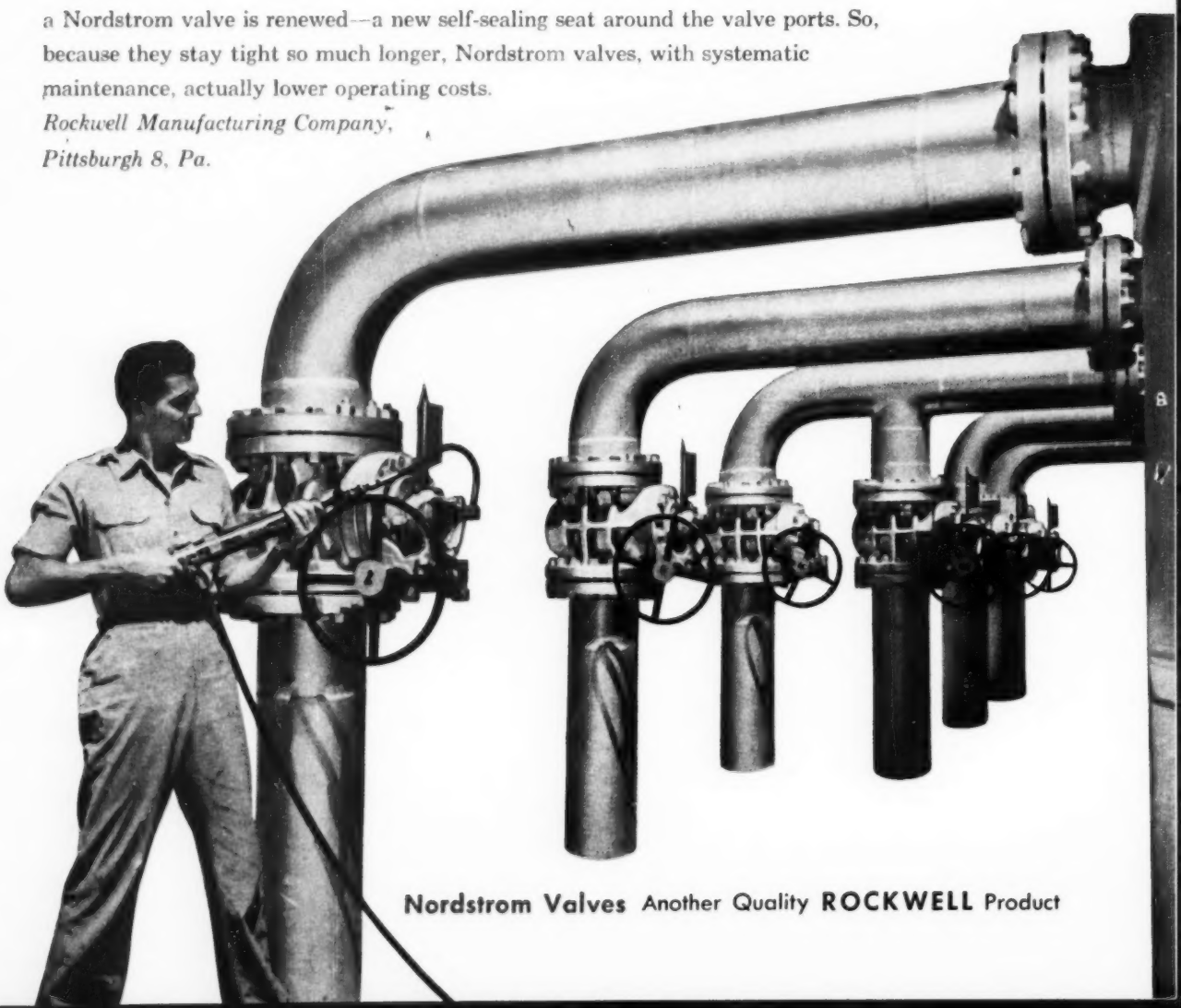
A NEW VALVE

properly maintained, stays new for many years—always tight, always ready to operate in an emergency, because the lubricant in a Nordstrom valve keeps erosion-producing seepage from starting in the first place, filling the smallest scratch on the seating area with a film of plastic sealer.

EVERY TIME IT'S LUBRICATED

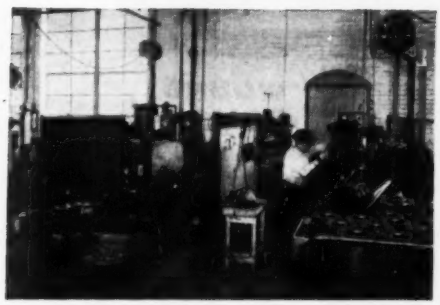
a Nordstrom valve is renewed—a new self-sealing seat around the valve ports. So, because they stay tight so much longer, Nordstrom valves, with systematic maintenance, actually lower operating costs.

Rockwell Manufacturing Company,
Pittsburgh 8, Pa.



Nordstrom Valves Another Quality **ROCKWELL** Product

Why Grinnell is America's #1 Supplier of PIPE HANGERS *and* SUPPORTS

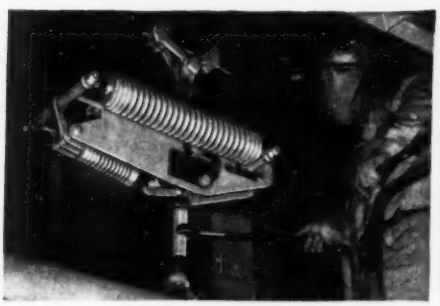


GRINNELL, ALONE, MANUFACTURES A FULL LINE OF HANGERS AND SUPPORTS

No other company, anywhere, makes a line as complete or varied. Grinnell produces hangers in thousands of combinations to support any piping.

GRINNELL, ALONE, MAINTAINS AN EXPERIENCED LABORATORY STAFF OF TRAINED TECHNICIANS

In its modern, well-equipped laboratory, tests are constantly being made to discover better ways of solving old and new pipe suspension problems.

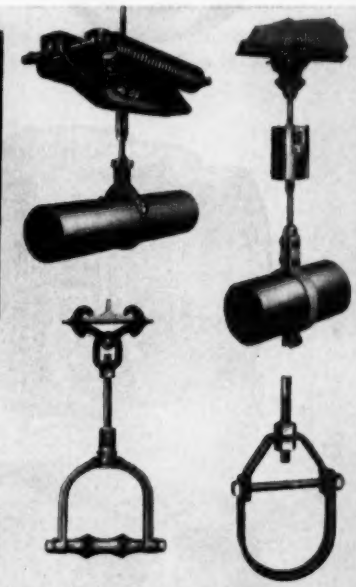


GRINNELL, ALONE, PROVIDES ENGINEERING ASSISTANCE IN DESIGN AND INSTALLATION

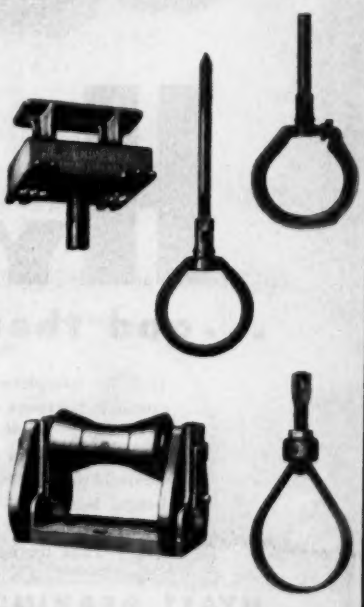
Grinnell makes available specialized knowledge in the computation of hanger loads and the selection of the correct supports. Engineers in the field assist with problems in erection of pipe hangers.

GRINNELL, ALONE, THROUGH ITS CONVENIENT WAREHOUSES CAN SUPPLY YOU "OUT OF STOCK"

No manufacturer of pipe hangers offers a distribution system as thorough or efficient. Grinnell warehouses are located in 30 principal cities . . . with jobbers in practically every city, coast to coast.



Grinnell makes scientifically designed, ruggedly built pipe hangers and supports for every type installation.



Pipe suspension presents an extremely wide range of problems involving weights, stress, thermal movement, materials and specialized engineering. No one "goes into" the pipe hanger business overnight. Large manufacturing facilities, skilled technicians, and a lot of down-to-earth practical experience are needed.

Grinnell has become America's No. 1 supplier of pipe hangers and supports only because Grinnell has specialized in piping for one hundred years. Grinnell has developed a line of pipe hangers and supports for every piping requirement, from the simplest to the most complex.

Grinnell is always ready to co-operate with engineers and architects in the preparation of pipe suspension specifications.

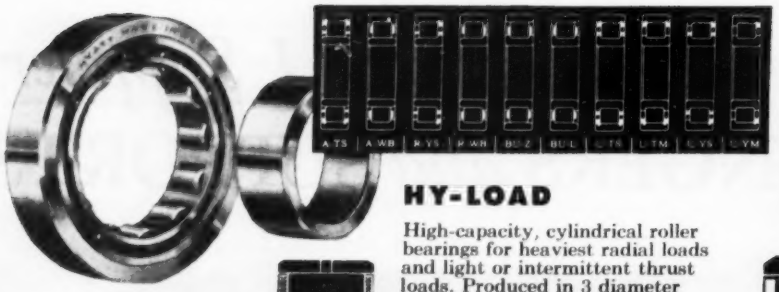
Call Grinnell for any and all types of pipe hangers and supports.

GRINNELL

WHENEVER PIPING IS INVOLVED

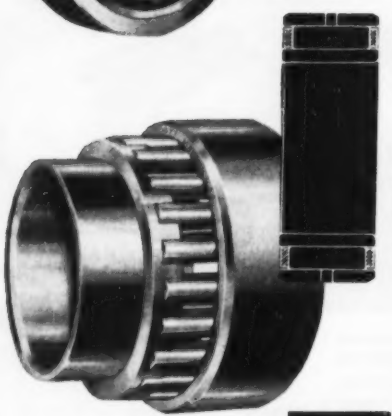
Grinnell Company, Inc., Providence, Rhode Island • Sales Offices and Warehouses in Principal Cities

pipe and tube fittings • welding fittings • engineered pipe hangers and supports
Thermolier unit heaters • valves • Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies • industrial supplies
Grinnell automatic sprinkler fire protection systems • Amco humidification and cooling systems



HY-LOAD

High-capacity, cylindrical roller bearings for heaviest radial loads and light or intermittent thrust loads. Produced in 3 diameter series, 2 widths and more than 800 sizes.

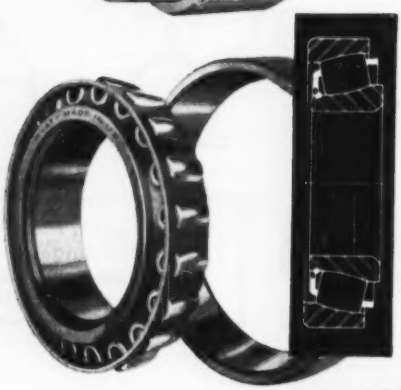


INDUSTRIAL INCH

Designed for slow-moving, heavily loaded machinery where large-diameter shafts are the rule. Accordingly, it is available in fractional-size bores for shafts from 4" in diameter upwards.

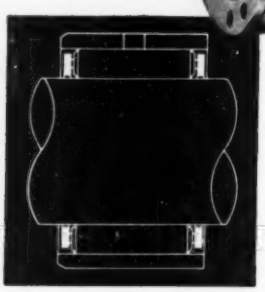
WOUND ROLLER

This is a three-part separable bearing available in various width classifications. The roller construction provides maximum resistance to shock, abrasion and fatigue.



BARREL

A series of angular-contact, self-aligning bearings capable of sustaining both radial and thrust loads. Race and roller curvatures insure ideal distribution of load, not only for normal operation but also for conditions of misalignment.



TRUNNIONED ROLLER

Ideal for industrial trucks, textile machinery, gear pumps, conveyors, hoists and agricultural equipment. Rollers have trunnioned ends which fit into holes in the end rings. End rings are located and held parallel by spacing bars which also guide and retain rollers.

DESIGNED FOR HEAVY DUTY...

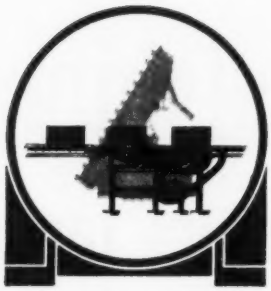
HYATT ROLLER BEARINGS

...and there's a type and size for every need

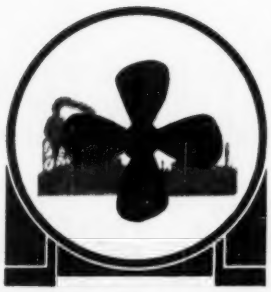
Hyatt's complete line of radial and angular-contact bearings—*more than 800 sizes in the Hy-Load series alone*—makes the engineers' job easier, because it makes possible greater design flexibility. For the equipment *buyer*, this means longer bearing life and lower maintenance costs—with just the right bearings designed into every vital load-carrying position.

The next time you buy new equipment, or make a changeover, *specify lower maintenance costs by specifying Hyatt Bearings!* And if you need technical help in your selection of bearings, or desire information about particular bearings or their applications, ask for the services of a Hyatt sales-engineer. Call or write Hyatt Bearings Division, General Motors Corp., Harrison, N. J.

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION



Material Conveying



Ventilating

When space is a problem, specify Fairbanks-Morse Axial Air Gap Motors.

Electric Motors

for every industry

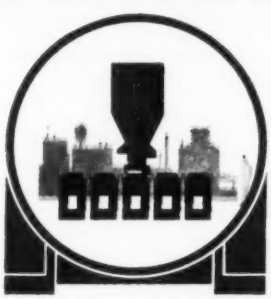
When you need electric motors . . . in any rating, or frame type . . . one or a thousand . . . *always* look for the Fairbanks-Morse Seal. For over 120 years it has stood for the finest in manufacturing integrity to *all* industry.

Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

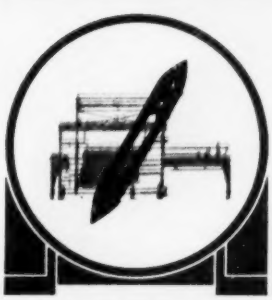
a name worth remembering when you want the best

ELECTRIC MOTORS AND GENERATORS • DIESEL LOCOMOTIVES AND ENGINES • RAIL CARS • PUMPS • SCALES • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS



Food Processing

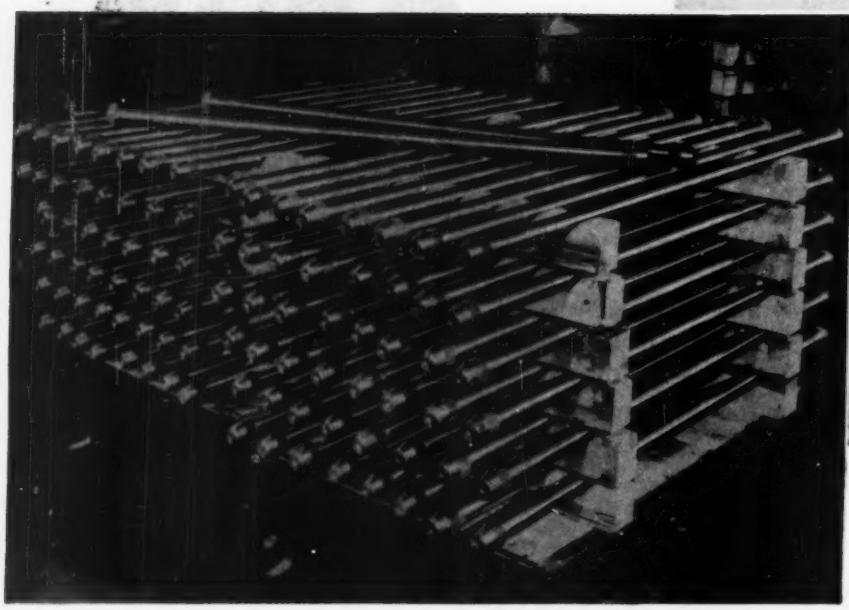
Metal Cutting



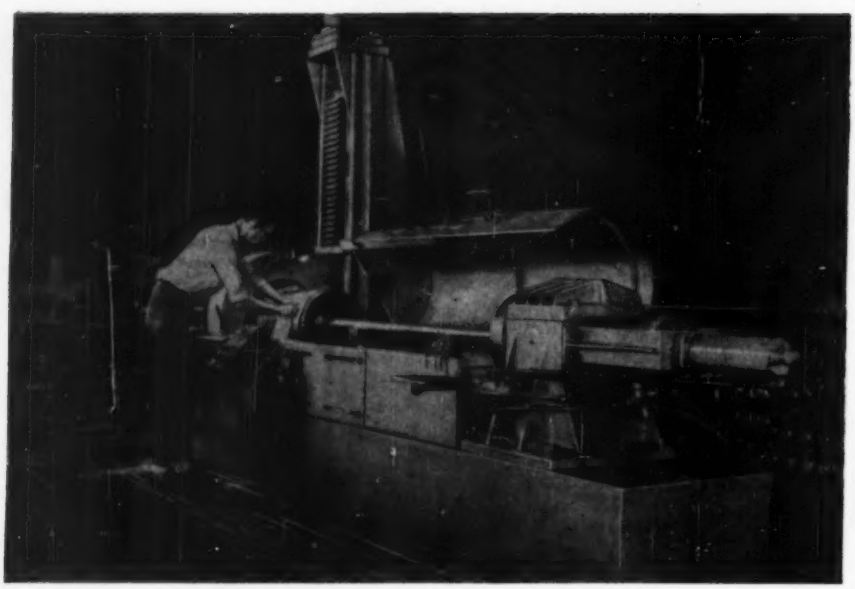
Textile Manufacturing

U·S·S Carilloy steel cushions

on the world's finest medium tank

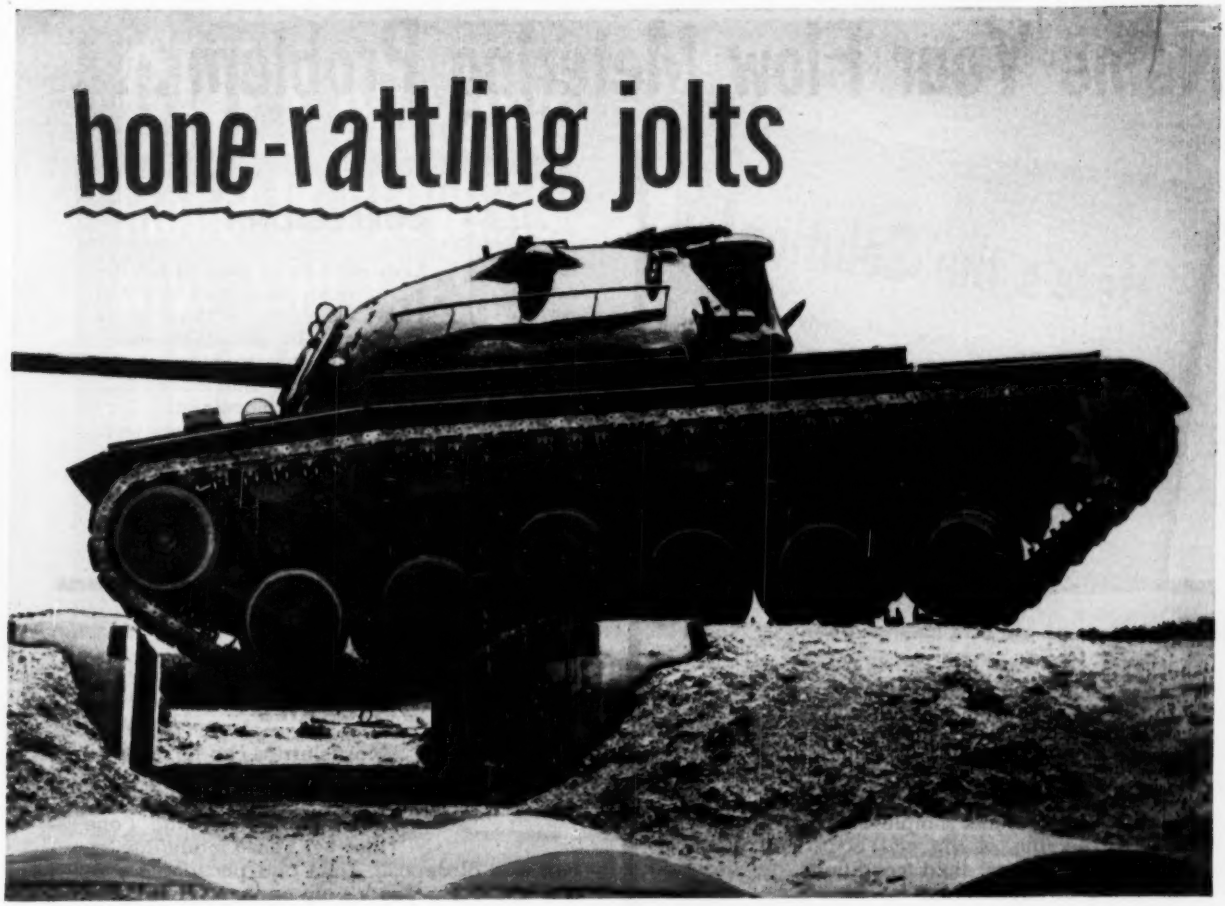


HERE ARE THE Carilloy steel torsion bars ready for shipment. Torsion bars are used on the Patton 48 and others so that the tanks can be built closer to the ground, giving a lower silhouette.



ON THIS TWISTER at the Cicero plant of Maremont Automotive Products, Inc., the finished Carilloy steel torsion bars are prestressed before shipment to the tank manufacturer.

bone-rattling jolts



THE army's amazing new Patton 48 not only moves faster, shoots straighter, and offers better protection to the tank crew, but it has a vastly improved suspension system that features torsion bar springs made of U·S·S CARILLOY steel. As a result, it rides lower and more level with less jarring than World War II models.

During rugged field tests, this 45-50 ton tank rolls along at more than 30 miles an hour, knocks down telephone poles and houses, rumbles over deep trenches and scales 3-foot walls. All the while, the CARILLOY steel torsion bars that support the driving wheels flex, twist, and vibrate. They smoothly absorb most of the jolts as the tank forges ahead.

Torsion bars withstand this heavy pounding . . . and do a better job of cushioning these shocks than previous spring systems. What's more they take less space, so the tank can be built closer to the ground, giving it a lower silhouette than other models.

U·S·S CARILLOY 8660 is a Ni-Cr-Mo electric furnace steel which possesses the required hardenability needed in these torsion bars. It will produce a minimum hardness of 55 Rockwell "C" at 9/16" from the quenched end in the standard End Quench hardenability test. It has exceptionally good surface and subsurface qualities.

Both the U. S. Army Ordnance Corps and the spring manufacturer, Maremont Automotive Products, Inc. are well satisfied with this excellent performance.

U·S·S CARILLOY steels are doing many tough jobs like this on both military and civilian products. So no matter what type of steel problem you have, we have probably met and licked one very much like it before. We can help you solve yours. Just get in touch with our nearest District Office, or write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Carilloy USS Steels

ELECTRIC FURNACE OR OPEN HEARTH — COMPLETE PRODUCTION FACILITIES IN CHICAGO OR PITTSBURGH

UNITED STATES STEEL

Name Your Flow Metering Problem . . .

Here's the Solution!

Difficult metering jobs — formerly so "impossible" to maintain as to be abandoned or not even attempted — have proved to be successful routine operations with the Foxboro d/p Cell. Here are just a few typical examples:

CORROSION

Corrosive fluids such as fuming nitric acid, SO_2 and dry Cl_2 can be handled without seals or purges, by the all-316 stainless steel construction of the d/p Cell. For materials which attack 316 stainless steel, the negligible displacement (3cc) of the d/p Cell permits use of liquid seals without seal pots, or loss of seal fluid due to pumping. Successful installations include mercury sealing of anhydrous HF, and oil sealing of 30% H_2SO_4.

FREEZING

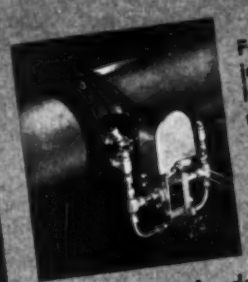
Flowing fluids that freeze at ambient temperatures can be metered without difficulty by the d/p Cell. Its unique construction permits simple steam tracing or electric heating of the cell body and meter leads to maintain fluid conditions. Accurate metering of naphthalene for ratio flow control with oxygen in the production of phthalic anhydride is typical of numerous services for which d/p Cells are currently employed.

SLURRIES

Most slurries can be metered directly in the d/p Cell. For the more concentrated types, a small liquid purge (one liter per hour) maintains the cell free of deposit. Lime and phosphate slurries and 4½% paper pulp are typical of many materials now being handled.

COAGULATION

Plugging of meter lines by materials that coagulate or polymerize is held to a minimum by the small displacement of the d/p Cell. On synthetic rubber latex, for example, reliable metering has been obtained; production downtime for instrument maintenance has been practically eliminated; and routine clean-out time has been reduced 87%! (Details given in Rubber Reserve report available from Foxboro.)



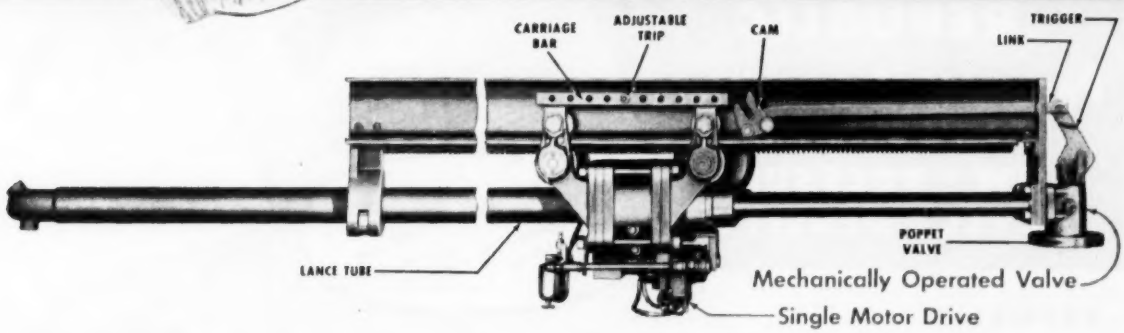
For your simple, "everyday" jobs of metering steam, water, hydrocarbon and other common fluids, the d/p Cell offers equally important advantages. Its light weight and simple piping make installation easy and economical . . . its sturdy, simple design practically eliminates maintenance. Write for detailed information on the d/p Cell or its application to your particular problem.

THE FOXBORO COMPANY, 9612 NEPONSET AVE., FOXBORO, MASS., U.S.A.

FOXBORO REG. U.S. PAT. OFF. **d/p cell**

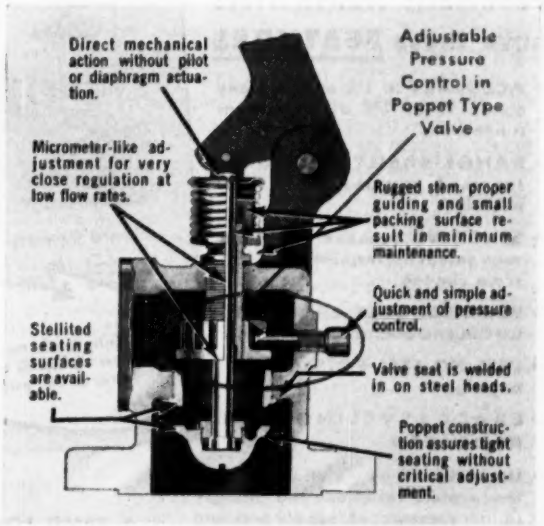
FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

ONLY DIAMOND Model IK BLOWERS GIVE YOU THESE THREE



The Diamond Model IK Long Travel Retracting Blower does an efficient job of cleaning tube banks of all kinds. It is particularly suited to locations where gas temperatures are too high for permanently installed multi-nozzle blower elements. It cleans by action of powerful jets from the end of a traveling and rotating lance tube. The close, helical blowing pattern (a sweep every inch) thoroughly cleans soot, dust, and most slag deposits over a wide radius.

The three features described here are all vital to the economy and dependability of any long retracting blower. ONLY Diamond Model IK gives you these THREE.


Direct mechanical action without pilot or diaphragm actuation.
Adjustable Pressure Control in Poppet Type Valve
Micrometer-like adjustment for very close regulation at low flow rates.
Rugged stem, proper guiding and small packing surface result in minimum maintenance.
Quick and simple adjustment of pressure control.
Stellited seating surfaces are available.
Valve seat is welded in on steel heads.
Poppet construction assures tight seating without critical adjustment.

50th ANNIVERSARY 1903-1953

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

Yours

For the Asking—

New DATA BOOK

about **ALL**

REPUBLIC

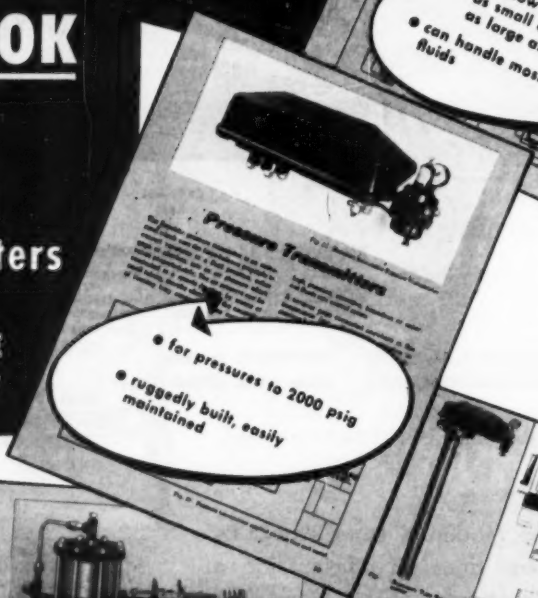
Pneumatic Transmitters

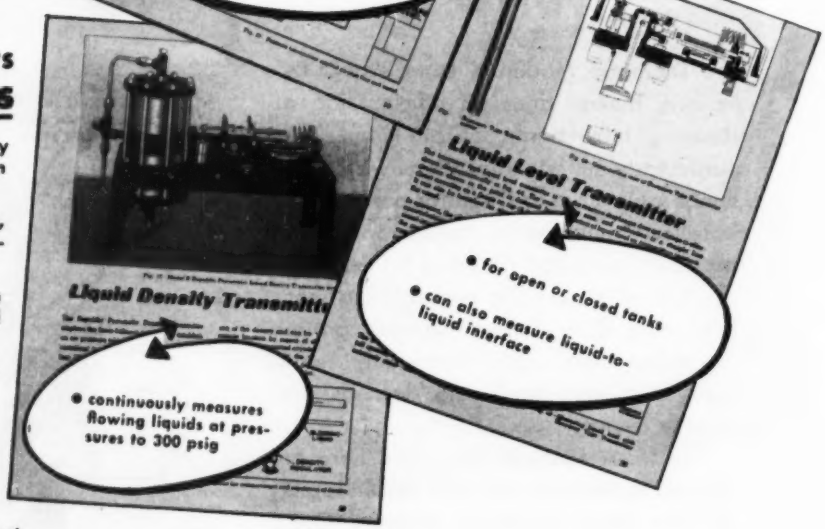
for Measuring

FLOW • PRESSURE

LEVEL • DENSITY

Differential Pressure Transmitters
• for flow and other differentials as small as 0-0.6" H20 and as large as 0-750 psi
• can handle most corrosive fluids




Liquid Level Transmitter
• for open or closed tanks
• can also measure liquid-to-liquid interface
Liquid Density Transmitte
• continuously measures flowing liquids at pressures to 300 psig

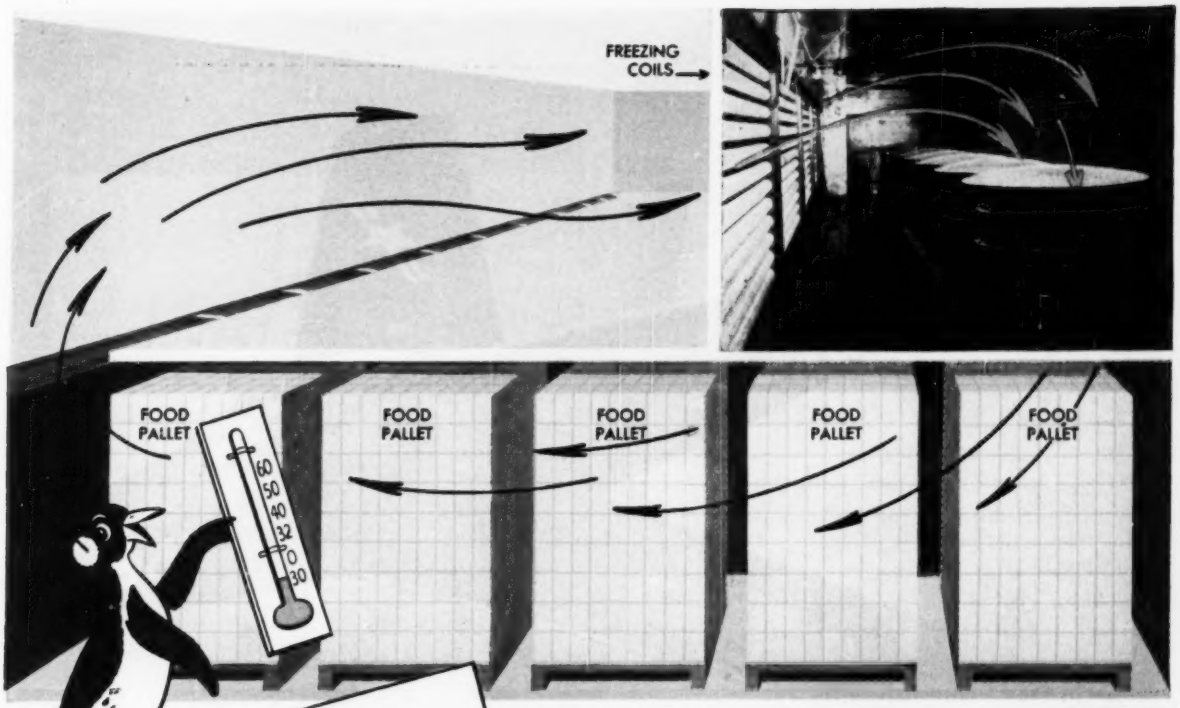
REPUBLIC
Pneumatic Transmitters have these FEATURES

- **ACCURACY** to 1% and in many cases ½ of 1% of maximum range scale
- **RANGE EASILY CHANGED,** reversed, suppressed or compounded
- **SENSITIVE** because minimum movement is required for full scale change
- **RUGGEDLY BUILT** for long service life and overrange protection
- **USES NO SEAL POTS,** mercury or purge
- **EXACT LEVELING NOT REQUIRED**
- **UNAFFECTED** by vibration, ambient temperature variations and changes in line pressure, air supply pressure and fluid density

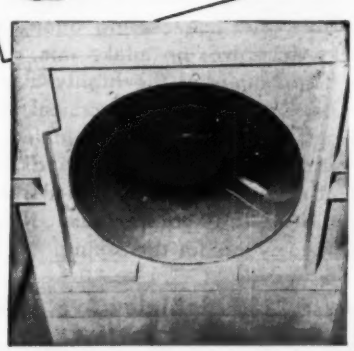
• SEND FOR DATA BOOK 1004 TODAY—NO OBLIGATION

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois



JOY
® AXIVANE FANS
HANDLE SEVERE QUICK-FREEZE JOB



Left: Looking up from the quick-freeze room below a Joy Axivane Fan. Note the compact, economical use of space and the simple mounting.

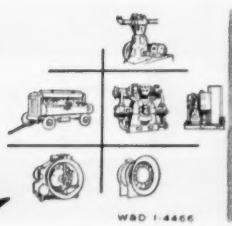
A West Coast quick-freezing plant boasts an effective operation that utilizes 24 Joy 7½ HP Series 1000 Axivane Fans, installed in two groups of 12 each.

Note the illustration above. The upper floor contains freezing coils and a row of 12 fans. The floor below is partitioned into narrow freezing tunnels, each served independently by a single Joy fan.

As air passes through the freezing coils, it is cooled to between —30° and —35°. This sub-zero air is propelled down and through the tunnels below, which contain pallets of meat, vegetables, fruit, etc. to be quick-frozen. After passing over the food, the air is again cooled and circulated. At full plant load, each 12-fan battery handles 242,000 CFM of air.

The relatively quiet operation, light weight, compactness and low power consumption of Joy Axivane Fans—due to the unmatched efficiency of their vaneaxial design—have proved *real* advantages on this job. Their in-line construction also saves space, since each fan can be mounted right in its short, vertical duct. In addition, extreme flexibility of operation is made possible by the adjustable blades, a standard Joy feature. ● Let us help you to get best results on your fan problems. ***Joy Manufacturing Company, Oliver Bldg., Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Consult a Joy Engineer



WBD 1-4466

for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

The new North American FJ-2 carrier-based jet fighter

Production Teamwork puts the NAVY FURY in the Air!

AMONG the many specialists supplying component parts for the Navy's new "Fury" Jet Fighter is Parker White Metal Company. Parker Die Castings are used on the upper fuselage door access assembly, fuselage cooling duct system, fuel system, air fuel locks, air valves on intake ram, surface control system and as components of the highly classified gun-camera. Parker Die Castings are economical, strong and light weight. Machining is virtually eliminated, thus reducing costs. You will find Parker Die Castings highly practical from your point of view. Consult with Parker engineers on your next die casting requirements. Nearly a half century of experience is yours for the asking.

and when you think of Die Castings **THINK OF**

Parker White-Metal Company • 2153 McKinley Ave., Erie, Pa.

PARKER ALUMINUM *and* ZINC *Die Castings*

ONE OF A SERIES

You Get Many Benefits
by Specifying VICKERS® Hydraulics

Undivided Responsibility

From the time the surgeon grasps the scalpel until the last stitch closes the incision, he alone has complete responsibility for the success of the operation . . . and often the life of the patient. Because of the surgeon's specialized knowledge, no patient would think of having it otherwise.

Undivided responsibility is important in hydraulics, too. This is a significant benefit you derive from specifying Vickers Hydraulics. Since 1921, Vickers has accumulated a great store of specialized knowledge in hydraulics . . . and the line of equipment is so complete that Vickers is in position to take UNDIVIDED RESPONSIBILITY. There is no risk of incompatability of equipment and Vickers Application Engineers know how to combine components for optimum operation.

This is another of the many benefits you receive when you specify Vickers Hydraulics.

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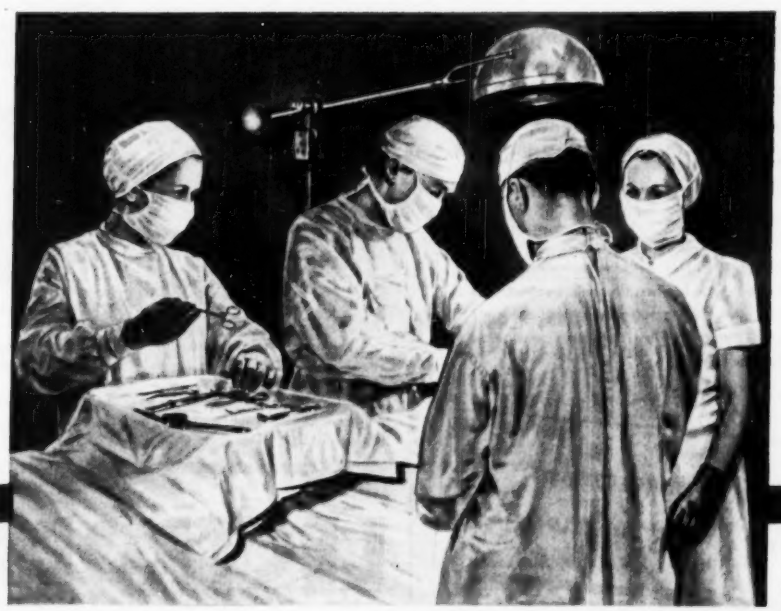

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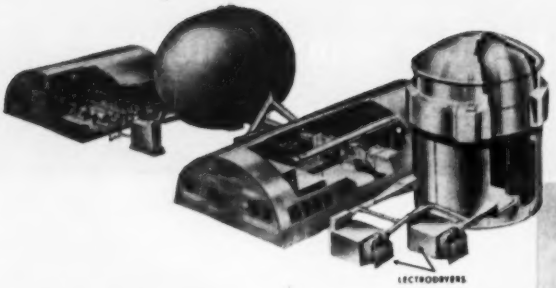
ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



Snow in a Wind Tunnel? Under stratospheric conditions normal air would cause a blizzard in a wind tunnel. Lectrodryers DRY three tons of air per minute here so this won't happen.

What in the world do you want to DRY?

You can DRY air or gases in volume to predetermined dewpoints as low as −110° F . . . to a relative humidity as low as 5% . . . even at pressures up to 6,000 psi.

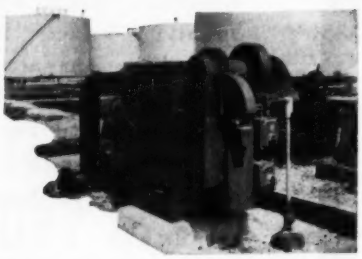
You can DRY organic liquids to a moisture content as low as 3 or 4 parts per million, or less.

All over the world Lectrodryer* machines are DRYing air, other gases and organic liquids to precise, low conditions, meeting the needs of industry and science. The examples illustrated show only a few extraordinary problems solved by Lectrodryers. There are thousands of everyday DRYing jobs being done successfully with these machines.

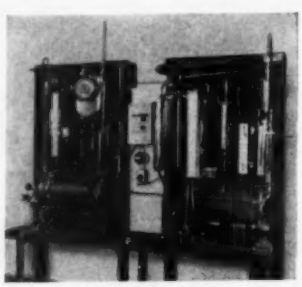
Write for *Because Moisture Isn't Pink*, a booklet describing Lectrodryers, their operation and function. Request engineering advice if you desire.
Pittsburgh Lectrodryer Corporation,
335 32nd St., Pittsburgh 30, Pennsylvania.

DRY Cement. High humidity and miles of ocean surround this cement ship. A Lectrodryer feeds DRY air to cement storage compartments, to keep cement DRY and powdery.

Safeguarding a Fortune. Philadelphia Museum art treasures require DRYness to prevent deterioration. A Lectrodryer keeps humidity low by feeding clean DRY air as required.



Protects Petroleum. Moisture condensing in storage tanks contaminates petroleum products. A Lectrodryer eliminates this problem by DRYing air breathed into tanks.



Saves Life. This machine samples carbon monoxide in highway tunnels. Lectrodryers DRY the air samples, assuring accuracy of reading by the automatic monoxide recorder.

DRYing Secret. What Lectrodryers are DRYing on Air Force crash trucks is "restricted" information. The DRYness specified is being adequately met by Lectrodryers.

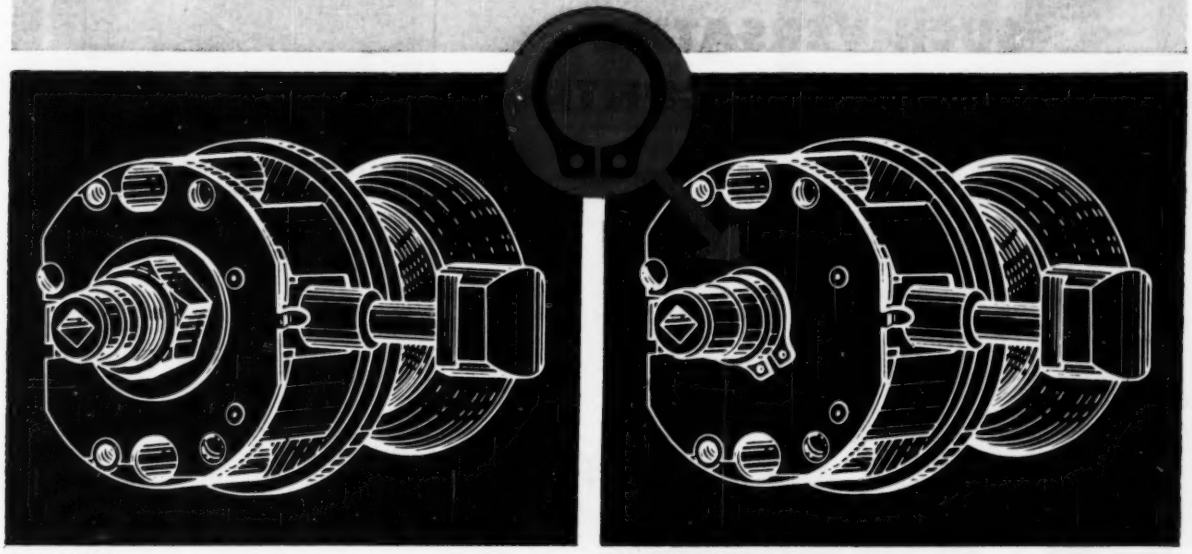
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

Waldes Truarc Ring Replaces Nut and Washer ...Cuts Costs $5.28 Per M...Speeds Assembly by 50%



OLD WAY. Main shaft required costly threading. Assembly was slowed by the double application of washer and nut and time-consuming tightening operation.

TRUARC WAY. Truarc Retaining Ring snaps quickly and simply over shaft. Lock assembly is secured in one fast operation. Virtually all play is eliminated from lock.

NEW DESIGN USING WALDES TRUARC RING PERMITTED THESE SAVINGS

OLD WAY

Cost of Nut	$10.00	*per thousand*
Cost of Washer	3.80	" "
Labor for Threading . . .	2.00	" "
Assembly	3.00	" "
TOTAL	**$18.80**	

TRUARC WAY

Cost of Truarc Ring and Grooving Operation . .	$11.52	*per thousand*
Assembly	2.00	" "
TOTAL	**$13.52**	

J. Chesler and Sons, Inc., Brooklyn, N.Y., manufacturers of the pre-assembled "Reddi-Mount" cylindrical lockset, uses a single Waldes Truarc Retaining Ring instead of an old fashioned nut and washer to secure the entire assembly of their lock. This new, improved fastening method enables Chesler to eliminate costly threading . . . save money on material . . . speed assembly time by 50% and produce an improved, more durable product.

You, too, can save money with Truarc Rings. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better, more economical job. Waldes Truarc Rings are precision-engineered . . . quick and easy to assemble and disassemble.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc engineers.

For precision internal grooving and undercutting...Waldes Truarc Grooving Tool

SEND FOR NEW CATALOG

WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,949; 2,416,852; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,420,941; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,308; 2,509,081; AND OTHER PATENTS PENDING.

ME 125

Waldes Kohinoor, Inc., 47-16 Austel Pl., L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print)

Name.....

Title .....

Company .....

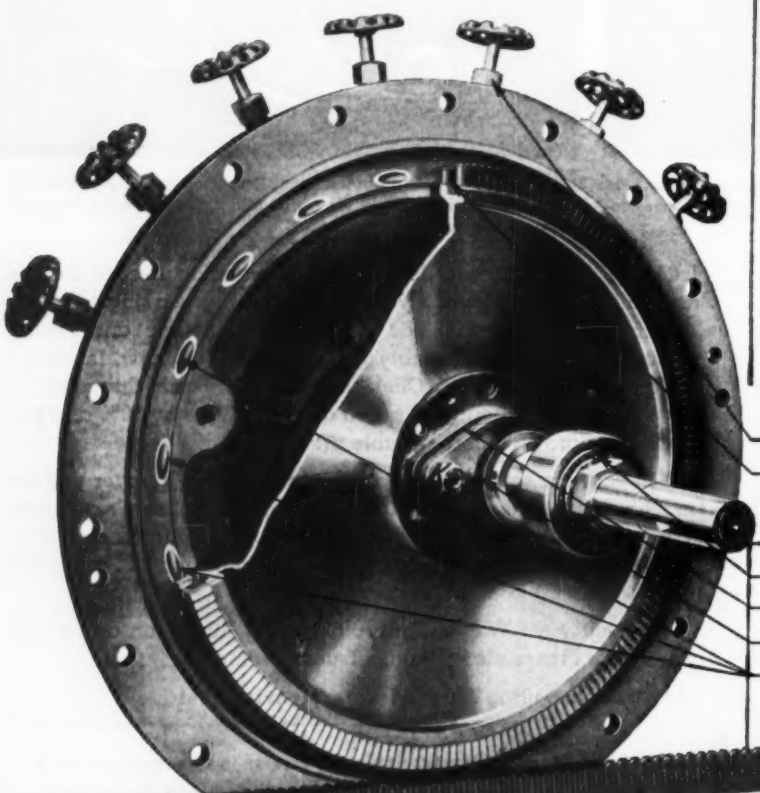
Business Address.....

City..... *Zone*..... *State*.....

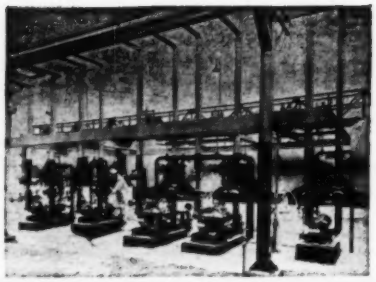
No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



- 7 hand valves for efficient partial load operation, (20" turbine shown)
- 2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced
- 30-40 carbon steel shaft
- Oversized double row deep grooved ball bearing
- Stuffing box with metallic packing ring
- Heavy chrome plating of shaft through stuffing box
- 3 nozzles always open



Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP., 372 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

Some present uses of Spongex Cellular Plastic

New material does old jobs better ... makes new jobs possible

Spongex cellular plastic (expanded unicellular polyvinyl chloride) performs outstandingly as a protective cushioning, flotation or insulation material.

This new material absorbs shocks with little, if any, rebound. Its light weight and ruggedness make it just about ideal for use in the aircraft, automotive and marine fields.

Perhaps Spongex cellular plastic offers a solution to one of your problems. Write to us today for complete information. We'll be glad to help.

Properties of Spongex Cellular Plastic

Insulates • Floats • Cushions • Low water absorption • Absorbs shock with minimum rebound • Unaffected by salt water or sunlight • Unaffected by oils, acids, perspiration • Fire-retardant • Has K factor of .20 • Needs no paint, finish or protective cover • Can be cut or molded to shape • Won't absorb odors • Non-staining • Lightweight • Non-toxic.

SPONGEX® Cellular Rubber

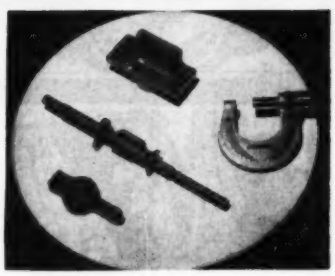
for cushioning, insulating, shock absorption, sound and vibration damping, gasketing, sealing, weatherstripping and dust proofing.

THE SPONGE RUBBER PRODUCTS COMPANY 601 Derby Place, Shelton, Conn.

They said this shaft couldn't be made at a practical cost

This small cam shaft was precision cast for Union Switch & Signal-Division of Westinghouse Air Brake Company. It is used in the control panel of the "Union" Retarder Speed Control and Automatic Switching – a system that controls freight car routing and speeds in the freight yard.

The lever and lever supports for the control panel were also precision cast and then chrome plated to improve appearance.



. . . but, Inco Precision Investment Casting proved it could be done

The Union Switch & Signal-Division of Westinghouse Air Brake Co., had designed a new control system for railroad yards. The system made it possible for one man to control the sorting and braking of all cars in the yard.

But one small part almost threw a wrench in the works.

It was a small cam shaft for the control panel of the unit.

To make it by machining just wouldn't be practical.

As small as this shaft is, it would require as many as six turning operations, six milling operations and lapping – plus the fact that more than half the 1-inch bar stock would be machined away into waste.

It was just too expensive an undertaking in both time and materials.

That's when the engineers of the Union Switch & Signal-Division called on Inco Precision Investment Casting specialists.

Our specialists precision cast the cam shaft – from 1050 steel – to tolerances of plus or minus .005" per linear inch. All that was needed afterwards was a little lapping of critical surfaces and a slight straightening of the shaft.

The engineers were more than pleased with the results. In fact, they even redesigned other parts in the equipment for precision casting. Those parts were cast of 1017 steel and chrome plated to improve appearance.

This is one of many examples of how precision castings can cut production costs and at the same time open up greater design possibilities.

In some instances precision castings save as much as 60 percent of production costs...Reduce machine shop bottle necks. Make possible the use of extremely hard metals. Frequently lead to economies through re-design. Reduce metal scrap. Often permit the use of a higher alloy which otherwise would be too costly.

Whenever you have a part which is 6" x 5" or smaller, weighs under 3 lbs., requires tolerances as close as plus or minus .005" per linear inch, and needs 5 or more fabrication steps, there is a good chance you can cut costs by having it precision cast.

For more information, write for a free copy of "Investment Casting – Its Advantages and Practical Applications." The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

SOME ALLOYS PRECISION CAST BY INCO

Nickel-Base Alloys
Ferrous Alloys
Austenitic Stainless Steels
Martensitic Stainless Steels
Ferritic Stainless Steels
Carbon Steels
Alloy Steels
Tool Steels
Cobalt-Base Alloys
Special Alloys

Inco Castings INCO TRADE MARK **PRECISION, SAND, CENTRIFUGAL**

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 75 NUMBER 12

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Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Dynamic," New York. Price to members and affiliates one year $3.50, single copy 50 cents, to nonmembers one year $7.00, single copy 75 cents. Extra postage to countries not in the Pan-American Union, $1.50; to Canada, 75 cents. Changes of address must be received at Society headquarters four weeks before they are to be effective on the mailing list. Please send old as well as new address. . . . By-Law: The Society shall not be responsible for statements or opinions advanced in papers or . . . printed in its publications (B13, Par. 4). . . . Entered as second-class matter at the Post Office at Easton, Pa., under the Act of March 3, 1879. . . . Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921. . . . Copyrighted, 1953, by The American Society of Mechanical Engineers. Member of the Audit Bureau of Circulation. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author and that date of publication be stated.

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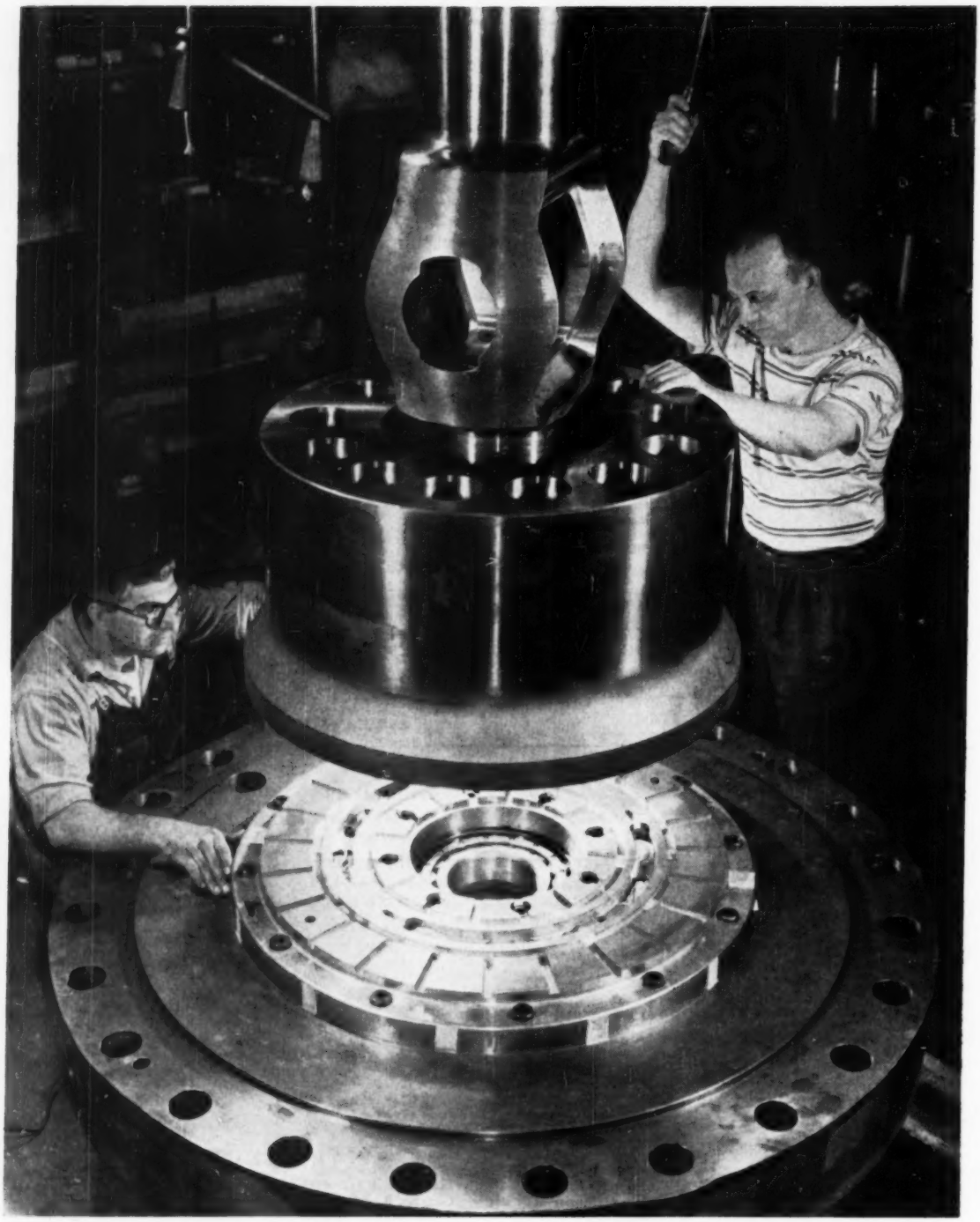

Checking Fit of Valve Plate Face to Cylinder Barrel Face During Assembly of High-Pressure Oil-Hydraulic Pump

(*See page 1007 of this issue for further details.*)

VOLUME 75
No. 12

MECHANICAL ENGINEERING

DECEMBER
1953

GEORGE A. STETSON, *Editor*

50 Years of Powered Flight

DECEMBER 17, 1903, is one of the significant dates of modern history. It was on that date that Orville Wright, an Honorary Member of The American Society of Mechanical Engineers, made the memorable flight in a heavier-than-air machine powered with an engine, at Kill Devil Hill, near Kitty Hawk, N. C., over a distance of 120 ft in 12 sec in a 27-mph wind. On the same day his brother Wilbur also made a powered flight in the same plane over a distance of 852 ft in 59 sec. Today we honor the Wrights for initiating fifty years of powered flight.

Scant public notice was given to this memorable feat of fifty years ago. Even in the home town of the Wright brothers the newspapers, as Charles F. Kettering reminds us in the address which appears as the first article in this magazine, were more interested in their probable homecoming for Christmas than in the historic event. And small wonder, perhaps, for had not Dr. Langley's failure to launch his man-carrying aerodrome earlier that same year brought him into public ridicule scarcely more than a week before?

How different is the situation today when we celebrate the fifty years of powered flight! Man, that earth-bound creature, who throughout recorded history has dreamed that his body might someday soar with his aspirations, has translated those dreams into reality. "If I take the wings of the morning," wrote the Psalmist; and Solomon declared, "There be three things which are too wonderful for me," among which was "the way of an eagle in the air." In a triumphant burst of exaltation the second Isaiah asserted that "They that wait upon the Lord . . . shall mount up with wings as eagles." Gazing at the heavens the ancients saw Phaeton driving the chariot of the sun from dawn to dusk, and the horned moon-maiden Io, "gadfly driven child of Inachus," forever making "her long pilgrimage unwilling, hunted still by Hera's wrath." They imagined Iphigenia, lured to Aulis by the wily Odysseus as a blood sacrifice, being snatched away by Artemis and borne to Tauris "through a great space of shining sky." In the nightingale they found the metamorphosed Aëdon, mourning for Itylus, her son. In legends they permitted the architect Daedalus to escape from Minos by means of wings he had contrived. They pictured Hermes with helmet and sandals equipped with wings, carrying the winged wand around which writhed the pythons he had killed, a symbol still associated with the medical profession From the gorgon locks of the slain Medusa they saw the winged horse Pegasus arise; and in the darker corners of their imaginative minds there lurked the griffen, half lion, half eagle, and dragons that breathed fire. And so down through the ages tales of magic carpets and witches' broomsticks have alternately delighted and terrified the questing mind of man, fascinated with the mystery of flight and the urge to fly.

Against this fantastic backdrop of hope and fear—of myth and folklore—stand the heroic figures of Roger Bacon and da Vinci, of the brothers Montgolfier, of Sir George Cayley, of Count Zeppelin, and a host of pioneers who brought science and the mechanic arts to bear upon the problem of flight and ushered in the era of air travel and transport so rapidly developed during the last half century. So it is that The American Society of Mechanical Engineers, at its 1953 Annual Meeting, under the auspices of its Aviation Division, takes its part in honoring the engineers' contribution to powered flight.

Of the prophetic vision of the Society's first president, Robert Henry Thurston, who in his second presidential address in 1881, said that "our only hope lies in the direction of flying machines, lifted by their own power, not buoyed up by gas," and of the subsequent developments in this new field of transportation and engineering as reflected by the papers presented at ASME meetings and the activities of the Society's Aviation Division, Harris F. Reeve, of the Flight Safety Foundation, writes in this issue of MECHANICAL ENGINEERING.

No member of the Society can read Mr. Reeve's "ASME Role in Powered Flight" without feeling a sense of pride in the part the ASME has played from the first years of its existence to the present day in man's conquest of the air. Nor can he fail to be impressed with the fact that the field of aviation is as broad as, and even broader than, the field of mechanical engineering and includes practically every ASME Division and interest. For there is scarcely an area of science or of engineering that is not invaded by those who are associated with aviation, as a list of titles of ASME papers will quickly testify. What was fantastic and visionary a few years ago has become commonplace today. And the end is not yet. For on the one hand, as Mr. Reeve points out, there is already being achieved a complete integration of airborne with other types of transport, while on the other, the fascinating prospects of interplanetary travel are undergoing serious investigation. Thus, out of the mists of legend and the fantasies of men's minds, the hard substance of machines for powered flight coalesces under the influence of modern science and engineering. To the long list of those who have aided in bringing about this amazing extension of human powers we pay tribute in this commemoration of fifty years of powered flight.

The Rice Lecture

THE distinguished editor of *Engineering* (London), J. Foster Petree, greatly enlarged the number of his friends during the past year by making two trips to this country and Canada, one in the spring and the other in the fall. He found himself greatly in demand as a public speaker and so well did he acquit himself in this field that he was invited to deliver the 1953 Calvin W. Rice Lecture at the Fall Meeting of The American Society of Mechanical Engineers held at Rochester, N. Y. early in October.

The Rice Lecture was instituted in 1934 to commemorate the service of that remarkable and internationally known Secretary of ASME under whose leadership the Society grew in numbers and influence throughout his administration from 1906 until his sudden death in 1934. Calvin W. Rice was a man of far vision and high idealism. In him these attributes had an infectious quality that communicated itself to other men, not only to those who worked under him and with him in ASME, but to their counterparts in other engineering and learned societies in this country and abroad. He was quick to visualize the broad significance of ideas that originated in his own mind or were planted there by other men and contemporary events. The fundamental kindliness of his nature and the words of encouragement and appreciation with which he rewarded the efforts of those who worked for him kindled in them a desire to emulate his enthusiastic and tireless service to the Society and the engineering profession. No worthy engineer, no matter from which one of the four corners of the earth he may have come, was ever turned away from his office without offers of help and letters of introduction. And as these engineers returned to their homes and Mr. Rice himself traveled abroad, his prestige as an international figure grew until, at the time of his death, he was one of the best-known personages in engineering and industry the world over. It was "to further his ideals and to increase understanding between engineers of the various countries and to broaden the programs of Society meetings" that the Calvin W. Rice Lecture was founded. The aim of the Lecture is "to bring leading engineers and scientists to lecture at national meetings outside New York," thus carrying forward the work to which Rice dedicated his life.

On many counts the choice of Mr. Petree as 1953 Rice Lecturer was especially appropriate. *Engineering* itself is closely associated with the early history of ASME. Undoubtedly most of the founders of the Society were constant and diligent readers of the magazine. Alexander Lyman Holley, Honorary Member in Perpetuity of the Society, who addressed the preliminary meeting as a result of which the Society was founded in 1880, went to England in 1863 to inform himself about the Bessemer process of steelmaking. With him went Zerah Colburn who was instrumental in the establishment of *Engineering* in 1866. Associated in this enterprise was James Dredge, who, upon Colburn's death in 1870, became co-editor of the magazine. In 1884 Mr. Dredge was elected an Honorary Member of ASME; and in 1890, while visiting this country, delivered an address at the unveiling of the memorial bust of his friend, Alexander Lyman Holley, located in Washington Square, New York.

Another link between Rice and Petree is to be found in the field of engineering journalism. Although Rice himself was not a writer or an editor, he had the vision to foresee the influence which Society publications would have on the progress of engineering and on the prestige and usefulness of ASME. There is little doubt but what Rice would have subscribed wholeheartedly to the functions of the technical press which Petree set forth in his address, "Position of the Technical Press in Relation to Industry," pages 967–969 of this issue. Although Rice's predecessor had acted not only as Secretary but also as Editor of ASME publications, Rice's vision of what Society publications might become led to the hiring of an experienced technical-magazine editor, Lester G. French, and to a greatly expanded and more comprehensive periodical publication, now known as MECHANICAL ENGINEERING. Mr. Rice greatly admired James Dredge; and he would have listened to Petree's address at Rochester with attention and approval.

Calvin W. Rice was internationally minded beyond the common habit of his time. In this respect, too, there is a connection between him and *Engineering*. For in spite of the fact that we usually speak of that magazine as London *Engineering*, or place England in parentheses after the name, we do so to identify it geographically, rather than to imply that either its readers or its interests are localized. Indeed, quite the reverse is true. It has been widely read and highly regarded in this country for generations. And wherever in the world there are engineers, *Engineering* has readers. To many in the far corners of the globe it is an essential link with the great brotherhood of engineers on the fringes of which they live and work. Through its pages engineering progress, theory and application, news of new materials and machines, details of important undertakings, and the comment of men who work in engineering pursuits are disseminated.

An international readership places responsibilities on the editors of *Engineering* that are not faced by a majority of the technical press. Among its readers are engineers who must dig out the meaning of its articles with the aid of a technical dictionary because they have no other means of translation into their native tongues. The English must be simple and clear. The content, rather than the form, is of prime importance, and there is no place for the trivial and the nonessential. Because other texts may not be available, material must be presented without reference to other sources. Articles so theoretical that an American editor would reject, summarize in nontechnical language, or assign to magazines devoted to specified interests must be printed in full for the benefit of engineers in remote areas where technical libraries are scarce. What Petree does in spreading engineering knowledge throughout the world bears a spiritual kinship to the objectives Rice sought in bringing the engineers of all nations into closer relationship. Readers of MECHANICAL ENGINEERING should be grateful to Mr. Petree for his exposition of these matters.

The ENGINEERS' RESPONSIBILITY *in* EDUCATING *the* PUBLIC

By C. F. KETTERING

RESEARCH CONSULTANT, GENERAL MOTORS CORPORATION, DETROIT, MICH. FELLOW ASME

ENGINEERING to me is simply an economic procedure. It is the process that controls the ratio between the man-hour of human labor on one side, and the useful result produced on the other. So, from the man who works with hand tools to the man who controls a great machine, each uses the levers and the processes which engineering and experience have created. People do not ordinarily understand the position of the engineer in our modern society.

In the presentation tonight of the Daniel Guggenheim Medal, two of my fellow townsmen were mentioned—the Wright Brothers. One of them, Orville, I knew and worked with for many years, and from him I learned firsthand the history and development of early aviation.

It is rather interesting how our mental attitudes toward things change. In the early history of our country the various churches had extension schools out through the West, and each year they sent one of the Bishops from the East to take a look at these rather primitive schools. On one such visit the Bishop was having tea with the instructor, a Mr. Horner, his wife, and some of their friends. And he said, "Mr. Horner, I think that you should not spend too much time on science, but put more attention on the church, because so far as I can see, we have uncovered every one of the fundamentals of nature, and therefore I think that we should not stress science. Mr. Horner, what do you think of that?"

"Well," he said, "I don't think so. Our knowledge of science is quite small. I think that men will fly some day just like the birds." And the Bishop angrily said, "For that you shall sizzle in hell."

That was Bishop Wright, the father of the Wright brothers. So sometimes you can't control your children. The 17th of December, 1952, would be the 49th anniversary of the first flight, and we still have one of the editors of a newspaper in Dayton who was in the same position forty-nine years ago and tells this very amazing story of the development of flight.

The Wright brothers had made three flights that day in a heavier-than-air machine, the longest of which was about the spread of our largest airplane. And so they wired their sister Catherine and said, "We have made three flights today with power. We are very happy and we are going to be home for Christmas."

When she got this momentous telegram she called the newspaper, because she thought that was quite a very important thing. She rang, and rang, and finally one of the boys answered the telephone. They were playing pinochle and they had to wait until the hand was out before they could answer. She said, "This is Catherine Wright," and she read the telegram. The editor said, "Good, I'm glad the boys are going to be home for Christmas."

"Now," he said, "Nobody can catch me on that one, because it had been proved mathematically that you couldn't fly." But it hadn't been proved experimentally that you couldn't fly. The Wright brothers were willing to try.

And so we need to have some methods by which we can especially show the younger people what the fundamentals of the thing we call "Engineering" are, and how to proceed with intelligent experiments.

* * * * * *

In one of the awards here tonight I heard mention of "Thermodynamics." I understand that there were, or are, three laws of thermodynamics, two of which I could never understand, but on the second one, recently I read a paper of some sixteen pages of differential equations, and it came out to be this: That you can't push on something that is going faster than you are. And I think it might be interesting to the kids in school to find that THAT is what that second law of thermodynamics is about.

I have been in an industry which has been off beam, so far as engineering education is concerned—the automotive industry. When I first went in it, there had been about 800,000 cars built in this country. And I have been associated with it while we have built 120,000,000. So I have been associated with it for about 99 plus per cent.

Now, our industry is very peculiar because so far as I have ever known, we have had no formula for it. I said to one of the presidents of a great university, "Why is it that you don't mention the pneumatic tire in any of your engineering books? We think that is one of the greatest mechanical inventions that has ever been made."

"But," he said, "We can't teach it because there are no formulas for it." "Well," I said, "Why don't you take the tires off your car, then, until you find out which is more important, the formula or the tire?"

So with our gears—many of which we use in the automobile—if you try to figure them out by the formulas, they would weigh more than the car. So, since we can't use gears like that, we just throw the formula out of the window, and go ahead and make them the way they will work.

* * * * * *

Your retiring president here is an oil man. Now I am not saying that disrespectfully, as many people might take it. Also, the new president of the Society of Automotive Engineers is an oil man. We think that is quite significant because the automotive industry is the result of about three things: First, rubber, petroleum second, and steels and their modifications third. And so we think that quite an accomplishment when two of the great engineering societies recognize that the fuel for some of these products they make is just as important as the product itself.

So what is engineering, then, going back to that point? We think it is the peoples' understanding of the economics of multiplying the effectiveness of an hour of human effort against the useful result. I think it was yesterday or the day before I

From a transcript of an address delivered at the 1952 Annual Banquet, Dec. 3, 1952, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

read in one of the New York papers that somebody had invented an electronic device which was going to eliminate the people from a factory. That sounded to me exactly like the old subject of technocracy, which some of you may remember. With the demand for hundreds and thousands of more people than we have in our shops now, a little help from electronics wouldn't come amiss.

But I would want nothing better if I were a young fellow in business than to have my competitor adopt such a robot because he would think he had arrived, and there is nothing in the world that is as good for a growing concern as a competitor like that.

I was on the stand down in Washington one time on a question of engineering, and engineering patents, and I was questioned about a certain piece of apparatus on which I had a patent. The fellow said, "Well, you're doing 70 per cent of the business in that field. Don't you consider that a monopoly?"

I said, "No, it would be a monopoly if we did all of it."

He said, "What do you mean by that?"

I said, "As long as we don't sell this product, and the customer insists on buying it, it can't be a monopoly."

Then he said, "You're trying to evade the question. You know you have patents on this."

"Well," I said, "I know we have some patents, but we have another thing that you are overlooking very, very much." He said "What is that?"

"Well," I said, "Our competitors all think we are crazy, and that is a much better protection than a patent."

It has been insinuated here at times that people don't grab new things right away, and that is something that we ought to think about in education. I have always wondered why it was that people were not much more energetic in taking a new thing. I have developed some new things and nobody ever paid any attention to them. One thing that you have to tell these kids is that no matter how great the idea is, if it isn't like something else, you will have trouble getting away with it. We will accept anything that looks like something else.

You take the diesel-engine business. The first twenty years they tried to make it like a steam engine and the next twenty years they tried to make it a gasoline engine. Now, all we did was try to make it like a diesel engine and it worked out very well.

There are a few things I think that engineers should learn, and one of them is that the word "design" is a treacherous word because you can't design anything that the material doesn't like. I have often told this old story of mine about when we were first developing diesel engines, and just for fun we put a couple of pistons in a display before the Society of Automotive Engineers in Detroit. We had cross sections and we also had cards saying how long they would run, and other data.

I dropped in there one evening and a fellow I knew came over and said, "I wouldn't have that piston that you fellows are using in an engine of mine."

"Why not?" I said, "Look at the card. That runs thirty times as long as the other piston." "Well," he said, "I can tell by looking at it that it's no good."

I said, "How can you do that?"

He said, "I'm an engineer."

"But," I said, "were you ever a piston in a diesel engine?"

"Well," he said, "I don't know how you ever went about designing a thing like that."

I said, "We didn't design it. We took a single-cylinder engine, put it on one of the dynamometers and we gave the engine a half-dozen pistons and said, 'You try these out and tell us which one you like best.' And this is the one the engine picked out. And to show you how much smarter the engine is than the engineer, this one runs thirty times as long as the one the engineer picked out."

So you don't have as much freedom to design as you think you have, and that is the reason for the research laboratories. There are certain jobs for which you can't have experimental models. Civil engineers can't make San Francisco bridges and try them out for years before they put them up. But in a lot of work you can make your experimental models and try them out through long periods of time until you find what is best.

A great many people try to depreciate this procedure by calling it cut-and-try, or trial and error. I said, "Why don't you call it trial and success?" because once in a while we do succeed. However, it is neither cut-and-try nor trial and error—it is experimental evaluation. It is the only way on earth we have of finding out what it is. Just as in the pneumatic tire, that's the only way we could find out, because of the enormous number of variables, even these 275 vacuum-tube computing machines aren't good enough to handle the variability in a pneumatic tire. So we have long ago resorted to types of integrating machines that are very much larger than those which most of you know about. We put two well-known tires on diagonal front and rear wheels of an automobile, and two new tires on the other wheels and take them out and let anybody drive them any place they want, any time, any way. So we use the roads of the country and the different ideas of the people, as the vacuum tubes in our integrating machine. At the end of 10,000 miles we look at the tires and see which looks the better. So it's not trial and error—it's evaluations by simple comparison.

So we need to tell this to the kids in our schools. All of them are getting afraid of our engineering courses because they think that some fellow can turn a key and ask them a question in mathematics and he's flunked out. And that is the reason why he studies economics and business management, because they haven't any trick questions like that in their courses yet.

That is the reason we are 34,000 engineers shy, because there are thousands of kids who would like to be engineers, but they are simply afraid of that differential equation or that integral sign. Now, let's explain to them what it is. It isn't nearly as bad as it looks, but let's tell them that there is only about 10 per cent of engineering that can be calculated and the other 90 per cent you have to do by experimental work.

In our business there have been very few things that we can calculate, and we always felt very happy if some competitor thought he could calculate them. In our business I have sat for thirty-five or forty years at the banquet table like this and listened to sales managers present next year's models when they say, 'Now, gentlemen, we are delighted that you met here. We want you to see the greatest car that this organization has ever produced and we doubt whether we will ever be able to exceed this." So everybody claps. Finally, the visiting dealers order all the cars they think they are going to make and everybody is happy.

Now, about a month after, they get out in the field and the competitors get hold of it—then the engineers begin to find that they overlooked something. That is the importance of having good competitors. They can see a lot of things that you never see at all.

So then they have the zone managers' meeting and they say, "You'd better get these engineers together here again, because it seems you have overlooked something." And so the general manager and the sales managers say to the engineers, "Now boys, that isn't quite as good as we told the convention it was." And then they start to make changes that will be in next year's model.

Our industry has come from the people. I think every garage, in every state in the Union, has contributed something to the automobile industry. We worked for years and years on our engines, and finally after many years we found theory wanted the engine to work the way it didn't want to. So I said, "Let's ask the engine what it would like to be." We found out that there were only two things we needed to know about an engine. One was its mechanical efficiency—that is, how much friction was in the engine.

Then these fellows from the oil industry came in and helped us with new lubricants and we finally got the mechanical efficiency up to about 80 or 85 per cent.

And then we introduced the other term. It is quite new and it is what we call combustion efficiency. That means how hot can you get the gas above the piston when the expansion stroke starts. Now, if you try to burn the fuel too fast, the temperature goes up and you radiate to the cylinder walls, and heat the engine, and you don't heat the gas. So that's the whole trick. I worked years ago on a material which maybe some of you have heard of, tetraethyl lead, which goes into gasoline under the name of Ethyl gas, and that was put in there to regulate the rate of burning so it wouldn't heat the engine, but it would heat the gas.

An understanding of the two factors makes possible our modern high-compression engines. We can still improve the efficiency about 25 or 30 or 40 per cent, depending on whether the engineers or the sales department tell you about it. If you did say 33 per cent, that is equivalent to getting a new oil well for every three that you now have, and it's much more pleasant to drill those oil wells in a nice office than it is out wading around in swamps or walking in deserts or wherever you may have to go. And it's just as effective as far as doing the work is concerned.

Regardless of what you think about it, our industry is a power industry. We have about fifty million internal-combustion engines in our automobiles, trucks, tractors, and other devices. In fact, we have enough automobiles in the country with only three passengers per car, to take everybody in the United States and move them at the same time. A great many of you think that that is happening on Sunday afternoon. However, I think you will still find a few at home. The importance of that power industry being able to turn over fifty or a hundred horsepower to an individual without having to get an engineer's license is very great.

Now, we have been able to produce a great deal of food in this country, and we have a lot of people who say they don't understand that we are now feeding about 200 million people. We have about 150 of our own, and we are feeding about fifty in other parts of the world. Well, the reason we can do that is quite simple, because in the last twenty years we have removed about 20 million horses from the American farms. Every time you don't feed a horse, you can feed four and a half people, so that's about 90 million people. And you don't have to farm an acre more of ground.

But everybody immediately said, "Well, you are using up your fuel supply." Well, now, I am not worried about our fuel supply because our engineers can improve the efficiencies of our engines so we won't use any more fuel. And if we have to raise fuel, I would rather use it as some hydrocarbon that we can produce, rather than raise hay and feed it to horses, because the efficiency of a poor engine is better than a horse you have to keep warm all winter.

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The question of what engineering can do for the country, for its economics over everything else, isn't understood. For instance, we think of Eli Whitney as being the man who invented the cotton gin. But one of the things he did that is of a great deal more importance than the cotton gin was the making of the individual tools to make a single piece or do a single operation upon a piece, which is the basis of our mass production. And many people need to know the fundamentals of mass production, and when you speak about tools, most people think of screw drivers and pliers. They don't think of these great presses, milling machines, and other special machines. They call that machinery. They don't understand what you mean by tooling up.

Now, the fellows who first introduced mass production were the printing people, and so when the first interchangeable type was made a new era was started. The tools of a great printing office, like the New York *Tribune* or the *Times*, are the great presses that they use to get out the papers that you will read tomorrow morning. I don't know how many thousands or hundreds of thousands they print, but they will all read alike if somebody doesn't find something in an early issue that he doesn't like and stops the presses and they reset them. Now, it doesn't make any difference whether what is in the copy is right or not—they are read the same. And so I have said we should get our people to understand that in modern engineering we don't manufacture products, we publish them. And the thing is just as much a useful idea whether it is published in metal or whether it is published in paper.

We have had three things in our country that have been tremendously important in our industrial development, of which this Society has been a great and controlling factor. We have had a certain amount of raw materials which have been available. We have had a certain degree—an amazing degree—of personal freedom. . . I mean you could do anything you wanted to do. But the third thing we have had since the earliest formation of our government is the importance of granting patents for new things. And a great many people do not understand that patent business. Very few people understand what a patent is, and you will never understand it either until you try to get one, or try to protect it after you get it.

Those things have made it possible for people who didn't necessarily have an engineering education—and I notice that one of your recipients here, Mr. Tribus, graduated as a chemical engineer. That is the reason why he was so unconventional as a mechanical engineer. And I have had three or four people who have been associated with me who have graduated, or not necessarily graduated, but have studied in our line of business and made a great success in another.

The late Dean Kimball of Cornell was a very good friend of mine, and there are three men whom I know have graduated from Cornell. One graduated in electrical engineering and turned out to be a great financier. Another graduated in chemical engineering and turned out to be the president of an insurance company, and another graduated in mechanical engineering and turned out to be a great chemist. Tom Midgley, who worked with me in the Ethyl gas business, was a graduate mechanical engineer. He never studied chemistry. I think he might have had freshman chemistry in his engineering course up there, but Midge never had any chemical training, yet he died as president of the Chemical Society, which shows that you can learn things outside of school as well as inside.

When I spoke to Dean Kimball about this he said, "If you graduate from Cornell you can do anything." So, I have been trying to get our educators to recognize that the commencement is really and truly what we say it is, a commencement. But a lot of us try to make it the finish. They want to say, "I am an educated fellow, I've got a diploma."

One of the best educational stories I have ever heard was told to me by a professor of medicine in one of the medical schools in California. He said, "I have been teaching these boys for four years how to be a family doctor, and finally I had to give them this last lecture, and I said 'Now, you have been a pretty good lot. I have taken you to the accidents, the homes, and the hospitals, and wherever we could learn. I have tried to get you the best books for you to read. Now, this is the last time I am going to talk to you and there are a few things I have got to tell you. In the first place, I am afraid that about half of the things I have told you aren't so. Now that doesn't worry me nearly as much as the fact that I don't know which half it is. Therefore I would like you to go out with the idea that you know how to recognize a new thing in medicine, but don't depend on what you have learned here as being the final thing.' "

* * * * * *

When I spoke about its being difficult to get a new idea across, a friend of mine said that he finally came to the conclusion that the difficulty was that people wanted to be residents in time as well as space. You can live in a town, but you can live only for one day on the third of December, 1952. Tomorrow is going to be the fourth and nothing you will do can stop it. And that is the reason why we have a great many people talking about the good old days. I don't see why—we can't do anything about those. I would like to worry about the good new days that we are going to have because we can do something about those. And there are greater things to be accomplished. If you don't think so, go look at the museum. Remember that the things you are making today are going to be museum pieces fifty years from now and everybody will wonder how on earth people got along with that kind of thing.

Now, we can progress as long as we increase our knowledge about material, because to me engineering is just material and energy relationships, of which we know very, very little. So the opportunity of today, if we can get people to understand, is that we never arrive. Engineering is a transient process and we can never reach our goal as long as so many things are unknown and the inventor is always regarded as a screwball because he does not believe things are finished.

I was asked this very important question one day: What is the difference between a scientist and an inventor? Well, none of the scientific organizations give me credit for being a scientist, so I had to be an inventor. You people who know the textile industry know that we have the threads that run lengthwise in the loom. I believe they are called the warp. Those represent the sciences—the physics, chemistry, biology, etc. But it would be hard to sleep in a hammock made of just the warp. Now, the inventor is the fellow who puts the strings in crosswise. I think they call it the woof, and the strength of the fabric is just as much dependent on the woof as it is on the warp.

Well, you can see why the physicist doesn't like the inventor, because he only touches the physicist and then goes over and touches the mechanic, and then the chemist, and so forth. In other words, he goes crosswise and ties them all together. And one is just as important as the other, because if you don't have the warp, you wouldn't have anything to woof together.

So I think if we had our people understand, if you could go out and talk to schools, Rotary Clubs, and Kiwanis Clubs, and all the other kinds of clubs, and tell them in simple language what the thing is—remember, don't use any technical words because they don't understand them. It is like these curves that you plot on log paper. Only when you want to deceive to the greatest possible extent do you ever resort to that—because what you do, you plot a straight line to a crooked base, and you don't show it as being crooked.

One time we had to make some studies on the noise level of cars, and so our boys got out a very nice booklet in which they talked about decibels. I called in the fellows who wrote the paper and I said, "Well, tell me what a decibel is." And they said, "it's a tenth of a bel." I said, "I know, but how loud is it? Is it this loud, or that loud? Who can read that paper and tell me how noisy the car is?"

This was going to about ten of our important people, so I had ten decibel meters made up in which you could, if it said this was 12 decibels, press keys to make twelve and press a button and the meter would make a noise of 12 decibels. Well, what do you think we got back? Everybody said that is the first technical paper they ever read and understood.

So remember, saying words, which are Latin and Greek synonyms, doesn't answer the questions. We have had a number of those, of course. As a great many of you know, for many years I have been working on this question of why is the grass green—why isn't it some other color? And a friend of mine sent me a little book a couple of years ago. He was so excited when he found this book, that he called me by long distance and sent it by air mail.

It said the active principle in blue-green algae is phyco-cyanin. Algae, as you know, is the green scum that grows on ponds in the summer time. I happened to be down South at the time so I got on the phone and said to some of the boys, "What is the structural formula of phyco-cyanin?" I didn't hear from them for a few days, and then they said that no one knew. Then I called up Brentano's bookstore and asked for books on the subject and they couldn't find anything new. At home in Dayton I have the big Oxford dictionary of some 22 volumes, and while it doesn't have technical terms as a rule, I found phyco-cyanin. Phyco is the Greek word for algae, and cyanin is the Greek word for blue. So the active principle in blue-green algae is the blue in the algae. So we went out the front door, walked around the house, and came in the same place.

It's the same way with chlorophyll. Chloro is the Greek word for green, and phyll is the Greek word for leaf. Well, we don't know any more about it in Greek than we do in English. The leaf is still going ahead being just what it is, and of course, it doesn't care what we think about it at all.

* * * * * *

So we need to get across to the public that because you are an engineer, that you are not a different kind of human being than anybody else, but you do happen to understand certain things a little differently. But we have so overestimated the few things that we know, that we have sort of kidded the public in the communities in which we live, that because we have a few Latin and Greek synonyms, we are quite educated people. The Boy Scouts, the 4-H Clubs, and all such organizations of young people, would welcome your sitting down and explaining to them how things are. They would love to listen.

And so we need to tell our associates that we are not a special set of superintelligents that are different from any other people, that we make just as many mistakes, and maybe more, only we try to describe it in such language that the management doesn't understand it. And sometimes we get our salaries raised on account of the language.

But you have contributed so much, so very, very much to the welfare of this country, that the public ought to know what you have done in terms they will understand. And you should tell it to them not as propagandists, not as egotists, but as faithful servants of the great public which you serve.

New Developments in Liquid Heating of Plastics-Processing Machinery

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INTRODUCTION

WHILE liquid heat carriers have been used here and there for more than 30 years in the plastics industry, they are now generally being found to be the most satisfactory if not the only medium which can cope with the requirements of heating and cooling of plastics-processing machinery. Many plastics machines previously heated by a variety of methods are being converted to use liquids in order to keep up with the ever more exacting requirements of the plastics industry. Therefore designers and users of new machinery should be well versed in the possibilites of liquid heat carriers and systems.

It is the purpose of this paper to review the new developments in liquid heating and cooling of plastics machinery and to explain the superior ability of liquid heat carriers to meet the increasingly stringent requirements of the industry. The principles which must be understood in order to gain the full advantages of the application of liquids will be reviewed briefly, and the special requirements of calenders, extruders, injection-molding machines, and plastics presses will be discussed in order to point out the shortcomings of presently applied heat carriers.

The plastics industry is suffering from growing pains. The equipment which has served adequately in the past is now often unable to meet the current requirements for higher output, better quality and uniformity, and higher processing temperatures. While in the past it often has been possible to make minor changes in conventional equipment and get by nicely, completely new designs are now becoming more and more essential. One result of this process of evolution of plastics machinery is the addition of a complicated combination of heat-transfer controls.

While calenders only yesterday were operating at roll speeds of 25 to 40 yd per min, speeds of 100 yd per min are used today and there is talk of 200 to 250 yd per min (1).[3] Injection molders having a shot capacity of 48 oz were considered huge some years ago, but today 300-oz machines are in use (2). In many cases it is the problem of adequate temperature uniformity and control which restricts the output of existing machines—in other cases the need for greater heat transfer and higher operating temperatures. In the case of plastics calenders, the introduction of high-temperature water-heating and cooling has made possible the present high roll speeds. While electric heating has allowed increases in the capacity and operating temperatures of many extruders, it has not proved quite satisfactory; there are many complaints of hot spots and pulsations.

When heating alone was required, steam, electric, and simple oil-heating systems were satisfactory. However, new plastics and higher production speeds create so much frictional heat in the plastics that, in order to control properly, both cooling and heating must be applied, with a smooth transition from one mode to the other. Water-cooling in combination with steam heating has not produced good results and has caused considerable damage to the equipment. It is the ability of liquid heat carriers to provide smooth control from full heating all the way to full cooling which accounts to a large extent for their popularity today.

Today, when the question is asked of the plastics industry as in a recent case (3), "What would you like to see in the new designs?" one of the most common answers seems to be, "Give us a more positive and accurate temperature control which does not overshoot or lag, which is reliable and yet flexible." Usually the fault is not with the control instruments but rather with the design and nature of the heat carrier which responds to the controls. We have found that the use of liquid heat carriers can go far toward solving these problems.

The time has come to reconsider the problem of heating and cooling plastics machinery, to start from a fresh point of view, and to develop new machines which are designed to fill modern requirements.

Liquid heat carriers offer the following major advantages to the plastics industry:

1 Uniform temperatures over the entire heat-transfer surface.

2 Full-range heating and cooling over wide temperature ranges.

3 Accurate temperature control with quick response.

4 Separate control of a number of individual temperature zones with one compact heating and cooling unit.

5 Program temperature control of heating and cooling.

The heat-transfer requirements of modern plastics machinery cannot be met by superficial engineering. The cost of properly designed heat-transfer equipment is usually small compared with the losses resulting from poor production. While liquid heat carriers have much to offer, their application requires an understanding of certain fundamental principles and a sound background of experience. For these reasons we should like to discuss a few of the basic principles of application of liquids to plastics-processing equipment.

LIQUID HEATING DESIGN CONSIDERATIONS

Selection of a Suitable Liquid Heat Carrier. The liquid heat carrier selected must have a range of temperature sufficiently great to permit maintaining the anticipated plastics-processing temperatures, and satisfactory heat-transfer properties. Table 1 lists a few representative plastics materials and their approximate extrusion temperatures. A number of important plastics have processing temperatures well in excess of 500 F.

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[3] Numbers in parentheses refer to the Bibliography at the end of the paper.

Contributed by the Rubber and Plastics Division, and presented at the Annual Meeting, New York, N. Y., November 29-December 3, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

TABLE 1 EXTRUSION TEMPERATURES OF PLASTICS (4)

Material	Deg F
Vinyl	350–390
Ethyl cellulose	370–440
Polyethylene	400–530
Fluorothene	550–600
Nylon	450–625

Table 2 lists a number of currently used liquids together with the approximate temperature ranges in which they have been applied.

TABLE 2 LIQUID HEAT CARRIERS

	—Recommended operating temperatures— deg F	
	Minimum	Maximum
Water	40	400–450
Heat-transfer oils	100	500–550
Diphenyle chlorides (Aroclors)	50	550–600 (Hydrotherm 500)
Aryl silicates	0	600–650 (Hydrotherm 700)
Diphenyl, diphenyl-oxide mixture (Dowtherm)	70	650–700
Tetra cresyl silicate	50	750–800
Eutectic salts	320	1000–1200

It is difficult to recommend maximum operating temperatures for all liquids because these limits depend not only on the nature of the liquid, but also on the design of the equipment, especially of the heater. The heater must be designed carefully to prevent hot spots from causing decomposition and other difficulties. Forced-circulation heaters are especially satisfactory for this purpose. The heat-transfer properties of the heat carrier, such as the specific heat, viscosity, density, thermal conductivity and the range of practical heat-transfer coefficients, must be considered as well as pumping requirements, leakage characteristics, decomposition, corrosion, and so forth. Water has the best heat-transfer coefficient and the best over-all properties, but for high temperatures, over 450 F, excessively high pressures are required. The other liquids listed in Table 2 may be used at low pressures. Heat-transfer oils generally have the poorest heat-transfer properties and the highest viscosities at lower temperatures.

Design of Circulation Passages. The design and arrangement of the liquid passages must be considered carefully if the full benefits of liquid heat carriers are to be obtained, as in the design of any heat exchanger. The quantity of liquid that should be circulated through the passages depends upon the amount of heat that must be added or removed, the temperature drop which the fluid may be allowed to suffer between entering and leaving the machine (as determined by the permissible temperature variation of the heat-transfer surface), and the specific heat of the liquid. The cross section of the circulation passages should be determined by the liquid velocity which will result in the optimum heat-transfer coefficient. High liquid velocities must be obtained in the passages where good heat transfer is needed in order to obtain high film coefficients and correspondingly low temperature drops across the heat path.

Fig. 1 shows a representative diagram of the temperature gradient across the heat path. Usually the temperature drop across the metal wall is relatively small, making it comparatively easy to obtain accurate temperature measurements in this region. The temperature difference θ_i determines the amount and the direction of the heat flow in accordance with the familiar equation

$$Q = UA\theta \quad \ldots\ldots [1]$$

where the area A and the over-all coefficient of heat transfer U are fixed. For good temperature control it is not good practice to vary the liquid velocity but rather to maintain high velocities and correspondingly a high film coefficient on the liquid side at all times. Some liquid-heating control systems vary temperature and heat transfer by throttling the rate of liquid flow. In these systems the surface uniformity suffers and the control becomes sluggish, resulting in a poor control of temperature.

It will be noted in Fig. 1 that a substantial temperature drop

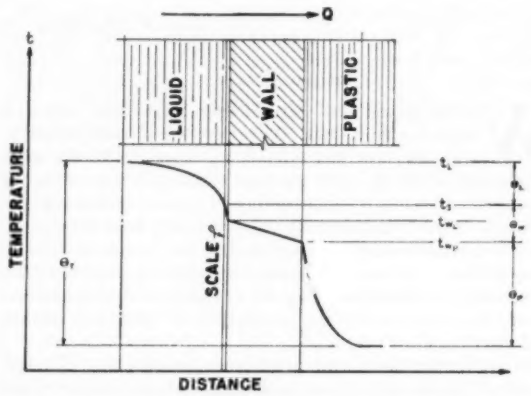

FIG. 1 TEMPERATURE GRADIENTS ACROSS HEAT PATH

can occur in the scale. This can be avoided by the proper use of liquids, since liquid systems are closed and impurities cannot enter the circuit from the outside.

PLASTICS-PROCESSING MACHINERY

Let us consider four basic types of plastics-processing machines and see how fluid heating can help solve their heat-transfer problems: (*a*) Calenders, used to produce film, sheet, and coated materials; (*b*) extruders, which produce continuous sheet, strips of various cross sections, threads, and coated wires; (*c*) injection-molding machines which inject molten plastic into molds under pressure; (*d*) plastics presses, used for compression and transfer-molding and laminating. Calenders and extruders usually handle thermoplastics, and presses and injection-molding machinery handle both thermoplastic and thermosetting materials.

Processing of plastics requires a number of basic steps. The first is mixing or compounding. Then the plastic must be "plasticized" or rendered into a plastic and homogeneous state at a higher temperature. After shaping or forming, it must be cooled. The mixing of plastics often requires considerable kneading of the plastic mass, with simultaneous heating. Plasticizing also requires kneading or mulling, together with heating, in order to produce a uniform plastic temperature. In some cases the plastic is viscous enough to be heated mainly by the frictional work done on it, while in other cases most of the heating must be done by heat conduction. Screw extruders and calenders often produce so much frictional heat that cooling of the material is required. In the case of extrusion, cooling is important around the feed hopper in order to keep the mass stiff enough to permit the feed screw to force it through the machine.

During the plasticizing process the plastic mass must be raised to a closely specified temperature in order to meet the requirements of the forming process, and to prevent damage to the plastic as a result of overheating. Injection-molding requires that the plastic mass be injected into a cooled mold at a

viscosity, temperature, and pressure sufficient for it to reach all parts of the mold before solidification takes place.

Thermoplastic materials require a final cooling phase, which in some cases is critical since excessively fast cooling may produce stresses in the finished plastic. Thermosetting plastics require a curing phase during which the setting reaction takes place. Careful temperature control is needed in the mold during this phase.

Each type of equipment and each type of plastic evidently requires heating and cooling at various phases of the process of conversion of the raw plastic into the finished product. In some types of equipment the plastic moves, passing a series of temperature regions, each having its own temperature-control problem. In other cases the plastic is retained in a container and the adjacent heat-transfer surfaces are subjected to a series of different temperatures in order to process the plastic. A more detailed discussion is required, to bring out the special requirements of each type of machine and plastic material.

CALENDERS

Four-roll calenders, such as illustrated in Figs. 2 and 3, are used currently for calendering plastics such as vinyls. The plastic is forced into banks before being forced through the nip between pairs of rolls. In these banks substantial frictional heating is created in the plastic. This, together with heat conducted from the roll, produces the proper processing temperature. If the roll speeds are higher than about 45 yd per min, so much excess frictional heat is produced in many vinyl compounds that cooling is required. Depending upon the operating conditions, each roll must be maintained at a different temperature, which may represent either heating or cooling. High-temperature water has been found to provide accurate control of heating and cooling for each calender roll. Steam cannot provide successful heating and cooling; water injection has not been found to be satisfactory (5). Steam-heated plastics calenders therefore are being converted rapidly to use high-temperature water. New designs have completely abandoned steam heating.

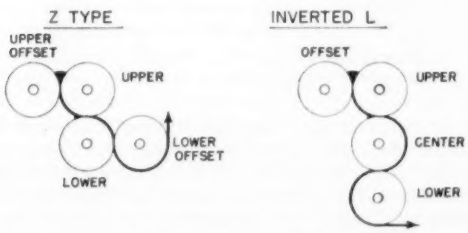

FIG. 2 CALENDER TYPES

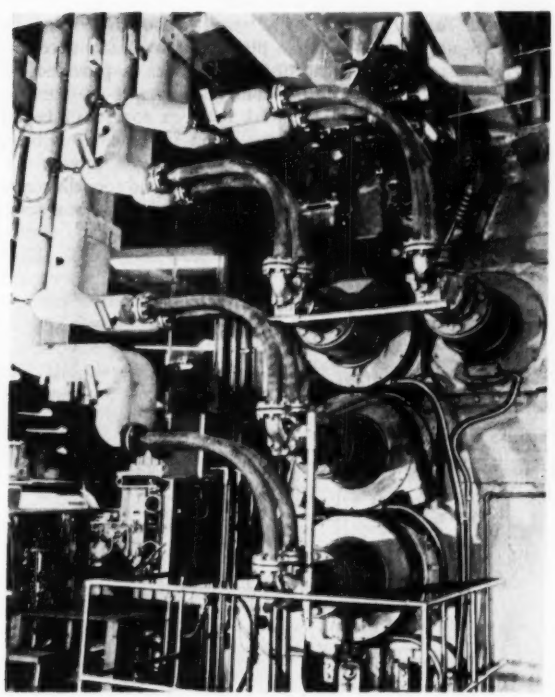

FIG. 3 FLEXIBLE HOSE AND ROTARY JOINT CONNECTIONS FOR FOUR-ROLL PLASTICS CALENDER

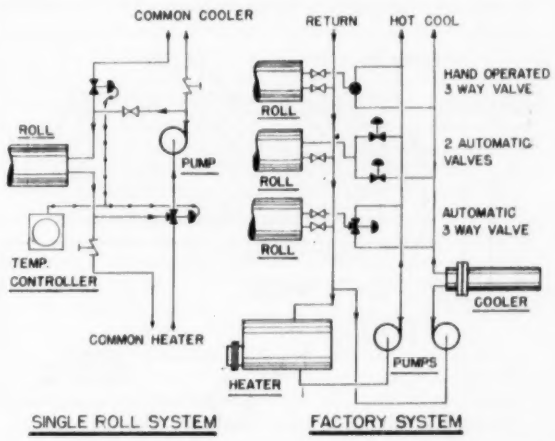

FIG. 4 LIQUID HEATING AND COOLING SYSTEMS FOR CALENDERS

Drilled rolls are now going into nearly all new calenders, permitting utilization of the full roll width (6). Cored rolls also have been found to operate satisfactorily with high-temperature water when adapted properly, although drilled rolls are preferable.

For the processing of most vinyl films, roll temperatures of 300 to 350 F are required, making high-temperature water the most practical heat carrier. In general, a deviation in the proper roll surface temperature greater than 5 deg F cannot be tolerated.

Design of Circulation System. Fig. 4 shows a circuit for heating and cooling of calenders, which also may be used in other plastics applications. Two fluid circuits are provided, one passing through a heat source which may be heated electrically, by steam or by direct fire, and the other passing through the cooler. These two water circuits are made available in front of each roll or zone and may be mixed in accordance with the quantity and direction of heat flow to or from the roll, to maintain any required temperature manually or automatically. If heat has to be absorbed, water at a temperature below the roll temperature is admitted; if heating is required, the temperature of the water is above the roll temperature. It may or may not be necessary to provide a separate pump for each control circuit. However, such a pump makes it possible to maintain a constant rate of circulation through the circuit at all times, permitting a smooth transition from heating, to neutral, to cooling. Fully

automatic systems of this type can maintain temperatures of one roll to a tolerance of 1 deg F.

Temperature Control. As already indicated, temperature control presents one of the greatest problems facing the plastics industry today. The difficulty does not lie in a lack of accurate instrumentation, as has been demonstrated by the number of eminently successful installations to date, but rather in the means of heating and the problem of obtaining a suitable means of indicating the very temperature we are trying to maintain—the temperature of the plastic itself.

A new calender surface-temperature control (5), invented by

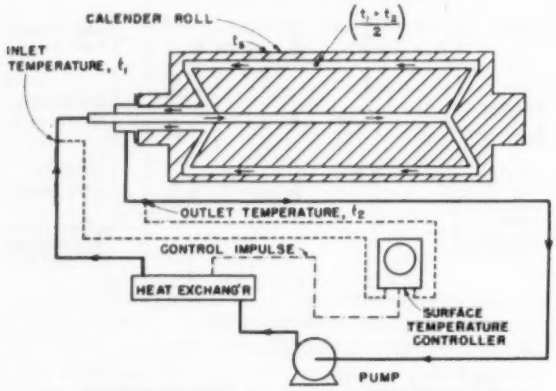

FIG. 5 CALENDER ROLL SURFACE-TEMPERATURE CONTROL

one of the authors of this paper, is illustrated in Fig. 5 which shows a control circuit for a calender roll. As the fluid flows through the roll from point 1 to point 2, its temperature suffers a rise or fall depending upon whether the roll surface temperature t_s, is hotter or cooler than t_1, indicating that cooling or, respectively, heating of the roll is taking place. The temperature difference $(t_1 - t_2)$ may be used to indicate the rate and direction of heat transfer, provided that the quantity of flow is practically constant. From this temperature difference the surface temperature t_s can be computed by the device, and the liquid temperature t_1 automatically adjusted to keep the surface temperature t_s constant at any desired level. This principle is the basis of the patent.

The real problem is to maintain a constant plastics temperature. Fortunately, in calender operation, the roll surface temperature is close enough to the plastics temperature for control purposes.

EXTRUDERS

The conventional plastics extruder produces various shapes by forcing the plasticized material through a die. A screw, continuously rotating, takes cold solid plastic granules or powder from a hopper and plasticizes the material by a combination of frictional heating and heat transfer in the cylinder of the machine and forces it out through the die. Fig. 6 (4) shows a simplified section of an extruder. In Table 3 a typical set of temperature conditions for extrusion of polyethylene is shown.

TABLE 3 TYPICAL POLYETHYLENE EXTRUSION TEMPERATURES (7)

	Deg F
Feed hopper	80
Cylinder:	
Back	300
Middle	400
Front	430
Head	460
Die	480
Screw coolant	115–185
Compound temperature	400–430

In general, carefully controlled cooling is required in the vicinity of the hopper to keep the viscosity high enough for the screw to "grip" the plastic. Then heating is applied through the cylinder jacket in order to raise the plastic to a suitable temperature for forming. A considerable variation exists in the amount of frictional heat created by different types of plastics at different screw speeds, and also in the temperatures required at different zones of the extruder.

In order for the machine to be versatile enough to take care of the requirements of different plastics, it is usually necessary that at least three independent heating zones be provided, together with a hopper cooling zone and separate die zone, so that the temperature differential between zones can be adjusted to suit the plastic and the speed at which it is being extruded.

In addition, it is often extremely important to cool the screw. For instance, in the processing of polyethylene it has been found

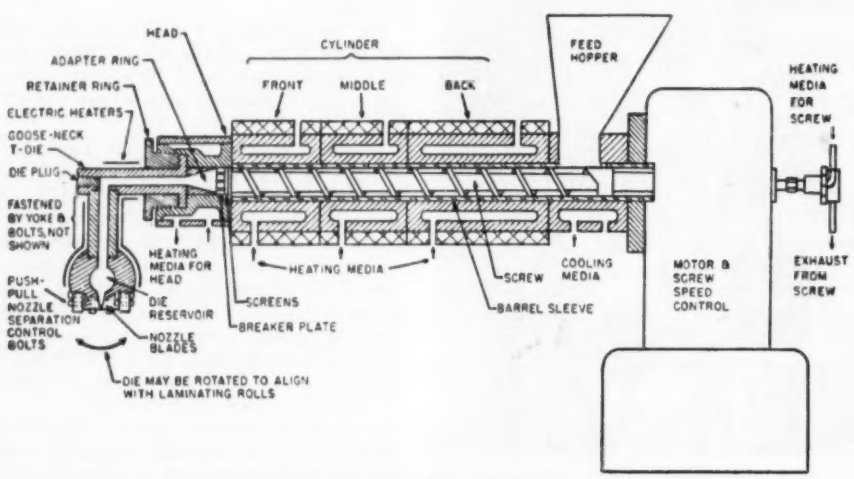

FIG. 6 HEATING AND COOLING ZONES OF PLASTICS EXTRUDER

that the screw temperature is a very sensitive control of the amount of work done by the screw on the plastic, and therefore of the entire operation (7). To obtain the greatest output from a given extruder, there is an optimum screw temperature for each screw speed.

Some plastics require cylinder temperatures over 600 F. For a plastics machine to handle plastics such as nylons and fluorocarbons, it is necessary to use a heating medium which can withstand these high operating temperatures. Steam and water cannot be used owing to the high pressures required. Oils cannot stand these temperatures without breaking down.

Electrical heating is commonly used, but users complain that hot spots and nonuniform heating result and that the units are excessively slow in cooling off, resulting in plastic damage and poor production. In addition, since a large amount of frictional heat is often produced in the compound, a direct electrically heated extruder can seldom be applied without producing a pulsating extrusion unless a means for removing the excess heat is furnished (8). Hence some plastics extruders are now heated electrically and cooled by means of circulating air, steam, or liquid passing through channels in the extruder cylinder in order to obtain the desired flexibility, better temperature control, and temperature uniformity.

Proper application of liquid heat carriers can make electrical heating unnecessary, greatly simplifying the heat-control system and making possible the use of economical fuel-fired heaters rather than costly electrical heat.

Many extruders in current use are heated by hot oil supplied by a constant-temperature source and throttled to each zone by means of hand valves. This system does not permit cooling nor does it give good temperature control. Users complain of the time lag which is required for a valve adjustment to produce a temperature change, and of nonuniformity of temperature. Such crude systems cannot achieve good results since they violate several of the principles we have mentioned already. A circulation and control circuit similar to that shown in Fig. 4 can be used, permitting full control of heating to cooling in each zone as required.

INJECTION MOLDING

In the process of injection molding, the ram of the injection cylinder takes the thermoplastic material from a hopper and pushes it by a reciprocating motion through the cylinder and injects it with a relatively high pressure through a nozzle into a mold. During the time that the plastic mass is being worked down the cylinder, heat must be added to bring the plastic to the proper injection temperature.

Fig. 7 (4) shows a simplified section of an injection-molding machine, equipped with a "torpedo" or "spreader" around which the plastic is forced to flow. This device causes the thick mass of granular plastic material to separate and flow through a narrow annulus, in order to bring the entire plastic mass to a uniform temperature prior to injection into the mold. The material becomes uniformly plasticized in a much shorter period of time than otherwise would be possible and without subjecting portions of the material to decomposition temperatures.

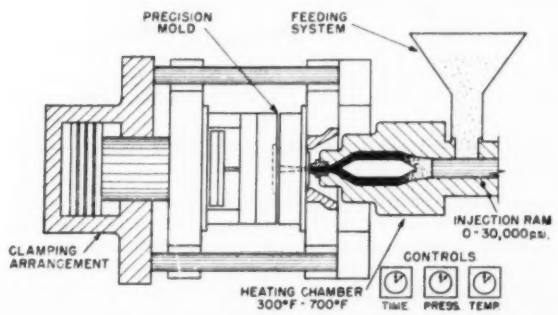

FIG. 7 INJECTION-MOLDING MACHINE

One of the limitations placed on the output of an injection-molding machine is the mass of plastic which can be heated uniformly to the required molding temperature. Injection-molding temperatures for styrene and nylon range from 400 to 700 F. Higher temperatures are usually desirable since they increase the capacity of the machine substantially. There is considerable demand within the industry to make available injection machines which raise larger masses to increasingly higher temperatures. Up to now electric heating has been used almost exclusively for heating injection-molding machines because of the insufficient heating area available in older machines.

The Preplasticizer. High-temperature liquids find their application in the injection-molding process in two places, i.e., for cooling the mold, and for heating the preplasticizer. Preplasticizers are now being incorporated into modern injection-molding machines in order to make possible the tremendous increase in capacity and the high processing temperatures required today (9).

When a preplasticizer is used, the injection cylinder is not required to heat the material from room temperature to molding temperature, or to perform the function of producing a homogeneous mass, so that there no longer is need for the torpedo. Owing to the increased heating capacity of the combined unit, much larger quantities of material can be handled. High-temperature liquids can be applied to the preplasticizer in much the same fashion as they are applied to extruders and offer the same advantages as just discussed.

The Mold. At one time it was considered satisfactory to cool the mold with cold water. Now it is generally realized that accurate temperature controls are required which provide not only for cooling but heating the molds. Thermal stresses are caused in many of the modern plastics unless the mold temperature can be controlled closely. Some plastics, such as Kel-F, require mold temperatures of about 300 F (10). Since the molding operation is controlled automatically, it is important that the mold temperature be maintained reasonably constant in spite of the cyclic nature of the molding cycle. One of the advantages of liquid heating media for this application is their ability to prevent sudden reductions in the mold temperature should the machine be stopped.

Numerous molding difficulties have been traced to wide temperature variations between the mold cavities. These variations are usually the result of circulating the heat-transfer medium too slowly and in poorly designed passages (11).

PLASTICS PRESSES

Plastics presses, usually hydraulically operated, are used for compression or transfer-molding thermosetting or thermoplastic materials as well as for laminating. As distinguished from the plastics operations we have just discussed, wherein the plastic flows from one temperature zone to another, plastics-press operations usually require that the plastic material remain in place while a series of temperatures are applied in a controlled cycle.

Modern plastics presses are equipped with automatic hydraulic cycling equipment which can be adjusted to close, dwell, and open in planned cycles, exerting exactly the required pressures on the plastic for the time required to produce the desired results. The time of the cycle depends upon the nature of the operation, the type of plastic, and the temperature of the

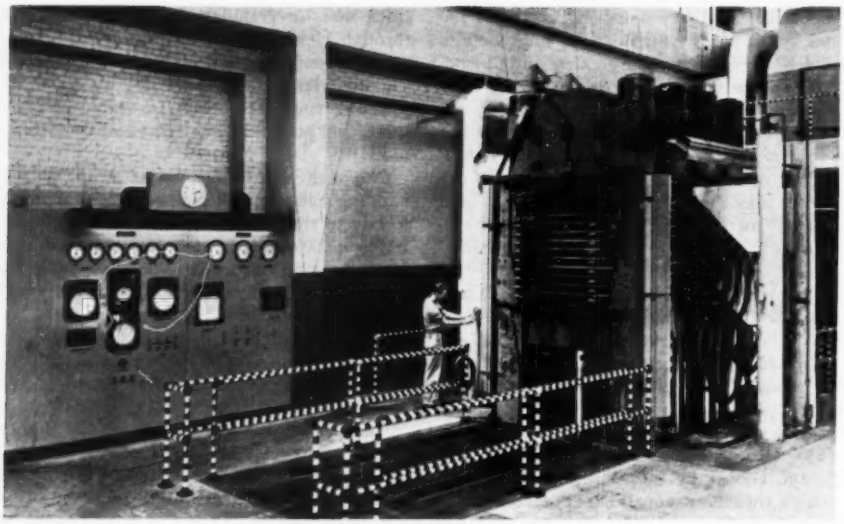

FIG. 9 PLATEN PRESS AUTOMATICALLY HEATED AND COOLED WITH HIGH-TEMPERATURE WATER

platen. For this reason it is necessary that the temperature-control equipment work directly in conjunction with the hydraulic cycle—heating up, maintaining the desired temperature, and cooling on a cycle such as illustrated in Fig. 8. The right-hand panel in Fig. 9 shows the controls for the hydraulic cycle; the left panel, the temperature-program controls. The temperature program is cut in the form of a cam which the instruments follow with close precision. Such automatic program control can be carried out only with liquids. Water is most commonly used for temperatures below 400 F. Plastics such as Kel-F are being processed in modern presses using Hydrotherm 700. Liquid heating systems for presses and dies are presently under construction with surface temperatures of 800 to 1000 F. These systems can be adapted to plastics processing, should such temperatures be needed.

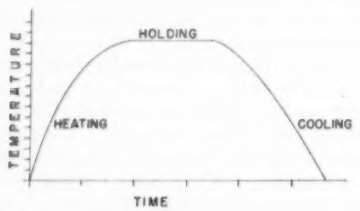

FIG. 8 PLASTICS PRESS TIME—TEMPERATURE CYCLE

Many press installations still use steam heat with water injection. This procedure produces tremendous thermal shocks, scaling of the heat-transfer passages, and for a number of reasons limits the rate and quality of production. More and more of these presses are being converted to liquids.

Liquids make possible the use of heat-accumulator systems to relieve the instantaneous load on the heating plant. Fig. 10 shows a liquid heating and cooling system incorporating an accumulator. It can be seen that this is essentially the same system used for calender heating except that an additional pump is used to circulate hot liquid between the heater and the accumulator, raising its temperature during the nonheating portion of the press cycle.

Fig. 11 shows a comparison between the instantaneous steam consumption of a typical platen press and that of the same press

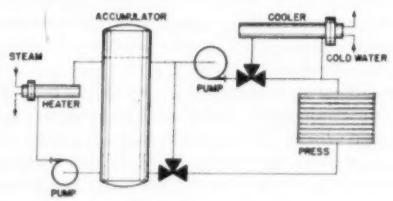

FIG. 10 PRESS HEATING AND COOLING SYSTEM WITH ACCUMULATOR

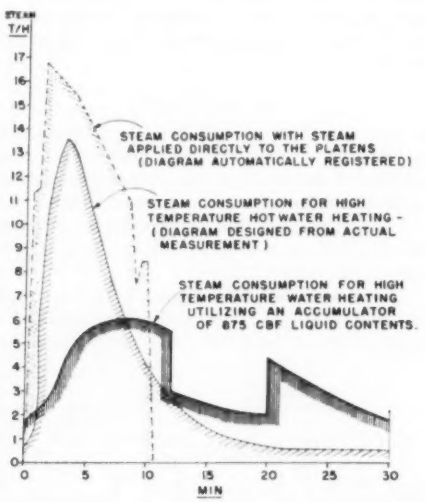
STEAM T/H
STEAM CONSUMPTION WITH STEAM APPLIED DIRECTLY TO THE PLATENS (DIAGRAM AUTOMATICALLY REGISTERED)
STEAM CONSUMPTION FOR HIGH TEMPERATURE HOTWATER HEATING - (DIAGRAM DESIGNED FROM ACTUAL MEASUREMENT)
STEAM CONSUMPTION FOR HIGH TEMPERATURE WATER HEATING UTILIZING AN ACCUMULATOR OF 875 CBF LIQUID CONTENTS.
MIN

FIG. 11 EFFFCT OF LIQUID HEAT ACCUMULATOR ON BOILER LOAD

heated with water with and without an accumulator. High-temperature water requires a maximum rate of 13.5 tons of steam per hr compared with a rate of 17 tons of steam per hr for steam heating. When an accumulator of 875 cu ft capacity is added to the system, the maximum rate of steam consumption is reduced to only 6 tons per hr. The heating plant for the system

(Continued on page 986)

CONTINUOUS WAX MOLDING

By RAY SHANNON

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INTRODUCTION

RISING costs and the need for additional wax-molding capacity prompted the author's company, in 1948, to review its wax-molding procedures. The batch-molding process then in use has been described by Jennings, Beard, and Kalichevsky.[1] Various other wax-molding procedures then available were investigated and rejected as not representing a substantial advance over the batch plate-and-frame process. Finally, a manufacturer of continuous chocolate-molding machines, the J. W. Greer Company, Cambridge, Mass., was approached with the idea of modifying one of its machines to mold petroleum waxes. The resulting continuous wax-molding process, which has been a subject of considerable interest and discussion,[1,2,3] was developed through the joint efforts of the two companies. The molding machine proper was designed and built by the J. W. Greer Company; the packaging equipment was supplied by the J. L. Ferguson Company, Joliet, Ill., and the conveyer system was developed by the Alvey Conveyor Company, St. Louis, Mo.

The basic objective was to design and construct a complete wax-molding process which would mold petroleum waxes continuously into slabs, package the slabs into cartons, mark the cartons, and deliver them to freight cars or trucks. An alternative operation was to be provided, allowing the packaging equipment to be by-passed and the wax slabs loaded directly in bulk form into freight cars or trucks. All operations were to be automatic, requiring as few personnel as practicable, and all machine components were to be designed for low maintenance.

EQUIPMENT

The wax-molding, packaging, and conveying equipment is housed in a building approximately 53 ft × 125 ft as shown in Fig. 1.

Wax Molder. The wax molder consists of a wax "tempering" system, pan-mold filling system, pan-mold conveyer chain, cooling facilities, and wax-cake dumping and discharge facilities.

The wax-tempering columns, Fig. 2, consist of a set of double-pipe heat exchangers through which molten wax is passed for the purpose of adjusting its temperature to the quantity desired. Steam-heated water is admitted to the annular space between the pipes. Automatic controls proportion the steam and water to achieve the correct wax-outlet temperature, the exact value of which varies with the type of wax being molded. The inner pipes are equipped with rotating scrapers which continually scrape the wax off the pipe wall.

The pan-filling system consists of a hopper containing molten wax, six wax depositors, and six depositor valves. The hopper is water-jacketed to maintain the correct wax temperature. Pan molds pass underneath the hopper in groups of six and are filled with wax while they continue to move. The depositors consist essentially of six variable-stroke plunger pumps with the plungers timed to operate in sequence with the passage of pan molds underneath the hopper. The six depositor valves provide passages for the wax to flow from the hopper into the cylinders on the upstroke of the pistons, and from the cylinders into the pans on the downstroke of the pistons. The six valves are operated in unison by a crossbar actuated by an air cylinder. Diffuser plates on the bottom side of the depositor valves direct the streams of molten wax into the pans without excessive splashing.

The groups of pans are carried in frames, six pans to a frame, which in turn are conveyed by two roller-conveyer chains

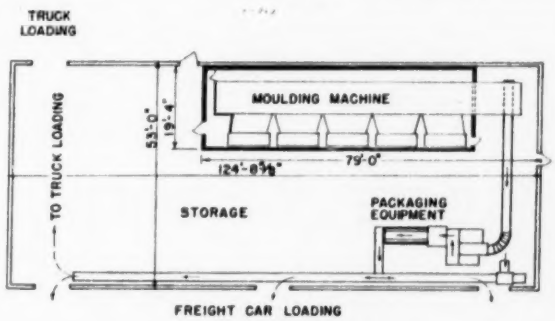

FIG. 1 PLAN OF WAX-MOLDING FACILITIES

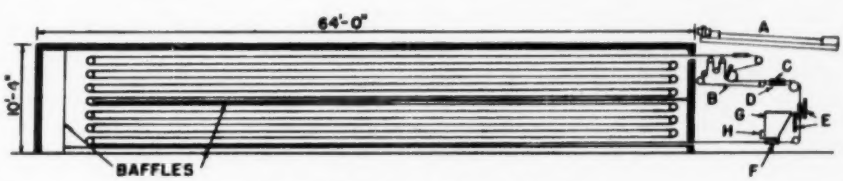

FIG. 2 SIDE VIEW OF MOLDING MACHINE

(A, Wax-tempering column; B, dumping conveyer; C, inverted pan in dumping position; D, discharge slat conveyer; E, pan heaters; F, pan approaching filling position; G, wax hopper; H, depositor.)

traveling at a speed of approximately 6.7 fpm. There are 418 frames, making a total of 2508 pans. The pans are 2 in. deep, $11\frac{3}{4}$ in. wide, and 19 in. long and are filled normally with 11 lb of wax. The pans containing the molten wax enter an insulated refrigerated room approximately 19 ft wide, 64 ft long, and 10 ft high, Fig. 2. The pans travel back and forth on the tiered construction in the cooling space and leave at the top through the same end that they entered. Normal residence time in the room is approximately 2 hr. The conveyer chains

[1] "Continuous Moulding of Paraffin Wax Is Effected," by L. H. Jennings, J. H. Beard, and V. A. Kalichevsky, *Petroleum Refiner*, vol. 30, August, 1951, pp. 97–100.

[2] "Continuous Wax Moulding Lowers Cost," by V. A. Kalichevsky, *The Oil Forum*, vol. 5, August, 1951, pp. 288-291.

[3] "Continuous Moulding of Petroleum Waxes," by B. Keyes, *The Oil and Gas Journal*, vol. 50, April 14, 1952, pp. 128, 131, 171, and 172.

Contributed by the Petroleum Division and presented at the Petroleum Mechanical Engineering Conference, Houston, Texas, September 28–30, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

are driven by a 10-hp electric motor through a main clutch, reduction gear, and chain-and-sprocket arrangement.

Provision was made in the design of the machine to transfer the pan frames to the next higher level at each end of the cold room while keeping the pans level and the wax undisturbed, since any shaking or vibration of the wax during the cooling process would mar the appearance of the cakes. The pan frames are attached to the conveyer chains by pivot pins in the center of each end of the frame. The four corners of the frames are equipped with rollers which travel on guides to maintain the pans in a level position. Chain sprockets of the correct pitch diameter elevate the frames to the next higher level as the chain passes over them. The rollers on the leading edge of the frame travel over curved guides while those on the trailing edge are engaged by stabilizing sprockets which rotate at the same speed and have the same pitch diameter as the conveyer sprockets.

Cooling in the refrigerated room is furnished by five Carrier direct-expansion ammonia air-handling units. Air is circulated over the wax pans as shown in Fig. 3. A 120-ton reciprocating ammonia compressor is located in an adjacent refrigeration plant. Normal temperature in the refrigerated room is 20–30 F.

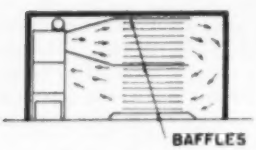

FIG. 3 CROSS SECTION OF MOLDING MACHINE

As the pan frames leave the refrigerated room, each pan is passed over a spring-loaded roller which flexes the bottom of the pan and loosens the wax cake. The pans are then inverted against a wide conveyer belt which moves at the same speed as the pans, and the cakes fall out of the pans onto the belt. Wax shrinks upon solidifying thus simplifying the problem of getting it out of the pans. The cakes are carried to the dumping station, Fig. 4, where they fall onto a slat discharge conveyer which is at rest while the cakes are being delivered to it. Immediately after a group of six cakes has dumped, the slat conveyer is set into motion and delivers the six cakes out of the machine onto a continuously moving conveyer belt, which carries them to the packaging equipment or to bulk loading.

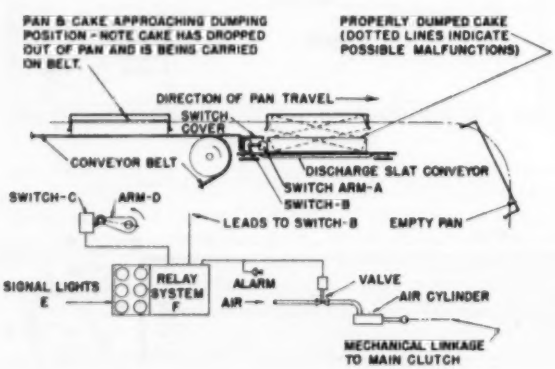

FIG. 4 DUMPING MALFUNCTION ALARM SCHEMATIC

(Dumping malfunction is sensed by failure of switch arm A to have switch B open during time arm D has switch C closed. Relay system F sounds alarm and opens air valve, thus admitting air to cylinder and stopping machine. Relay locks and is reset by hand. Signal lights E indicate which pan has failed to dump.)

The empty pans are heated by electric heaters before being refilled. This avoids sudden cooling of a thin film of wax in the pans.

Packaging Equipment. The packaging equipment automatically packages five 11-lb wax cakes to a carton and can handle 4 to 5 cartons per min. The equipment consists of a grouping plunger, case opener, case loader, glue machine, and compression unit.

The grouping plunger stacks the cakes five high and delivers them to the case loader. To begin operations, the grouping plunger is preloaded manually with four stacks of cakes, one stack consisting of four cakes, the next of three, the third of two, and the fourth of a single cake. These cakes rest on spring-loaded gates, and as cakes are fed into the machine they pass under the preloaded cakes. As soon as five cakes have entered, they are elevated past the spring-loaded gates and thus one cake is added to each stack so that there now are five stacks consisting of five, four, three, two, and one cakes, respectively. The grouping plunger then advances the entire group of stacks one cake width, delivering the five-cake stack to the case loader. The unit thus is returned to its original condition.

Knocked-down cardboard cases are loaded manually into the magazine of the case opener. The case opener removes the bottom case blank, opens it, and places it in position to receive five cakes of wax from the case loader. After the case loader has pushed five cakes into the case, it trips the clutch on the glue machine which applies glue to the flaps on the case, folds the flaps, and delivers the case to the compression unit. This unit holds each case under compression for approximately 2 min to allow the glue to set.

Conveying Equipment. Conveyers have been utilized to minimize the manual handling of the cakes and cartons of wax. Portable gravity conveyers are utilized to move the product from the loading conveyer into freight cars or trucks. It is only necessary to stack the cartons or cakes in the car. When cakes are being shipped in bulk form, the packaging equipment is by-passed and the cakes enter a wax-cake stacker which stacks them four high and delivers them to the loading conveyer. The wax-cake stacker is a modification of a semi-automatic packaging machine which was built by the author's company for use in packaging cakes while awaiting delivery of the automatic equipment.

OPERATION

Fully refined paraffin wax is the only type of wax that has been molded in the company's machine. Studies have indicated that amorphous wax may be molded with the addition of a complete filling system (tempering column, hopper, and depositors) to avoid contamination of the waxes. These additions have not been made yet.

Wax is maintained in a molten state in a feed tank outside of the building and is pumped through the tempering columns to the wax hopper. The pump is regulated by a float control arrangement in the hopper to maintain a fixed level of wax. The wax is filtered twice in its passage to the hopper as an added safety precaution. The tempering column operates automatically, either heating or cooling the wax as required to deliver it to the hopper at the correct temperature.

The melting point of the wax is the controlling factor in the molding process. The melting point of the waxes molded varies from 120 F to 140 F. It has been found by experiment that the wax should be deposited in the pans at a temperature 20–30 F above the melting point and should be cooled to approximately 20 F below the melting point before being dumped. The dumping temperature is referred to the center

of the cake. Failure to provide sufficient residence time results in cakes with soft centers and impairs their dumping characteristics. The cakes must be solidified completely in order to contract sufficiently to separate easily from the pan molds, which are provided with slightly sloping sides to aid in dumping. Too much cooling, i.e., lowering the cake temperature too far below the melting point, results in brittle cakes which tend to crack when subjected to shock loads in the conveying and packaging equipment.

The speed of the pan-frame conveyer chain can be varied from 3.66 fpm to 14.85 fpm with a normal operating speed of 6.7 fpm. Variation in chain speed thus allows for variation in wax-molding rates. Also subject to control is the cake weight which may be varied by changing the stroke of the depositor pistons. Normal cake weight for the company's machine is 11 lb, although cakes weighing 9 lb $6^1/_2$ oz sometimes are molded.

One surprising feature of the machine is the accuracy of the cake weights. While the machine was being built by the manufacturer, the author's company designed and built an automatic cake-weighing device which would weigh each cake coming from the machine and automatically reject those which were overweight or underweight. When the molding machine was put into operation, however, the device failed to reject any cakes. By manually weighing sample cakes and applying the methods of statistical quality control it was discovered that the inherent accuracy of the six wax depositors is such that the weight variation of 11-lb cakes is within 1 oz. Because of this accuracy, use of the automatic rejecting device has been discontinued. However, periodic checks are made of the cake weights, using statistical quality control, for assurance that the machine is maintaining its accuracy.

In Fig. 5 are presented data on the performance of the molding machine. Curve A, showing the relation between cycle time (the time required for one pan to travel completely through the machine and return to its original starting place, which would be slightly longer than residence time inside the cold room) and rate of wax production, was calculated for 11-lb cakes. This curve is determined by the mechanical characteristics of the machine (e.g., pan-frame conveyer-chain length, variation in chain speed, size of sprockets, and so on) and the weight of the wax cakes. A similar curve exists for each cake weight. Curve B shows the relation between the amount of refrigeration required and rate of wax production. This also is a calculated curve, based on removing 130 Btu/lb from the wax during the cooling and solidifying process, and shows the actual amount of heat removed, allowing for no losses. The slope of curve B will vary greatly with waxes of various melting points.

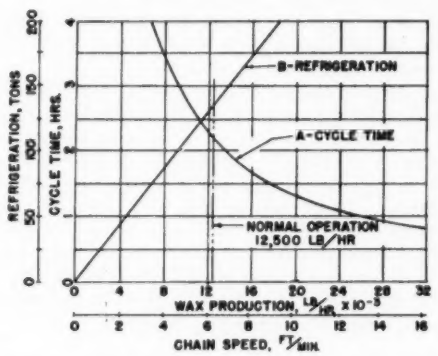

FIG. 5 RELATIONS BETWEEN REFRIGERATION, CYCLE TIME, AND WAX PRODUCTION, BASED ON MOLDING 11-LB CAKES

(Refrigeration is based on actual heat removed from wax.)

The curves indicate that the capacity of the machine could be increased greatly if sufficient refrigeration is provided, since the chain speed may be varied from 3.66 to 14.85 fpm as stated previously. This is true only in a limited sense, and it has not been found practical to increase the rate much above 12,500 lb per hr or a chain speed of approximately 6.3 fpm. Higher speeds are used when molding cakes lighter than 11 lb, but when molding 11-lb cakes it has been found that the sudden stopping of the conveyer chain, which occurs if any of the cakes fail to dump properly (see "Modifications"), causes wax spillage and disturbs the partially solidified cakes, if the chain is traveling at the higher speeds.

A comparison of the manpower requirements for the new molding process and for the old plate-and-frame batch process is presented in Table 1.

TABLE 1 COMPARISON OF NEW AND OLD PROCESSES

	Batch	Continuous molder
Capacity, lb per hr, of wax having average ASTM melting point of 130 F	4200	12500
Operating personnel per 8-hr shift:		
Operator	–	1
Operator helper	1	2
Machinist (trainee)	–	1
Labor	8	3
Total	9	7
Capacity, lb of wax per manhour	466	1785

MAINTENANCE

Modifications. Operating experience and maintenance problems indicated the desirability of several modifications and revisions which have been made on the machine. Certain modifications have been performed by the author's company while others were carried out in collaboration with the manufacturer.

It was discovered that rather extensive baffling is required in the cold room to direct the flow of refrigerated air over the pans in such a way as to secure adequate cooling of the wax without any subcooling. As shown in Fig. 3, air is directed across the top seven layers of pans and returns to the air-handling units across the lower seven layers. A baffle was installed underneath the bottom layer to force all of the returning air through the spaces between the pans, and a wall was installed across the end of the tiered construction, Figs. 1 and 2, to prevent short-circuiting of the air around the end. It was found that the cakes in the end pans nearest the air coolers were receiving too much cooling, and deflectors were installed to deflect the cold air over most of the width of these pans.

Some difficulty has been experienced owing to the failure of cakes to dump properly. Originally the machine was equipped with a vibrator to shake the pan frames when they had reached the dumping position to insure that all of the cakes had been loosened. This imposed severe shock loads on the mold pans and pan frames, and quite possibly contributed to a series of weld failures which were experienced with the pan frames. In an effort to secure a milder means of loosening the cakes in the pans, two sets of stationary spring-loaded rollers were installed to flex the bottom of each pan twice in its passage from the cold room to the dumping station. Neither

system is foolproof however, and cakes occasionally fail to dump, particularly if the dumping temperature is not correct. If a cake remains in the pan, a fresh 11-lb charge of wax will be deposited on top of it, resulting in wax spillage. If a cake falls partially out of a pan it will become jammed in the machine, necessitating stopping the machine to clean out the wax.

In an effort to minimize the consequences of a dumping failure, the system shown schematically in Fig. 4 was developed. The basic approach was to develop a device which would automatically stop the machine if any cake or cakes failed to dump, and to signal which cake or cakes failed. Six single-pole double-throw limit switches (B, Fig. 4), were installed with operating arms A protruding in such a manner that each of the six wax cakes which fall onto the discharge slat conveyer will operate one of the switches. The normally open contacts in these switches are connected to individual signal lights; thus when the wax cake operates the switch, the light for that cake signals that the cake has been dumped properly.

The normally closed contacts in switches A are wired together in parallel and the combination is connected in series with the cam-operated limit switch C. Switch C is operated by arm D which makes one revolution while the pans travel one pitch distance. Switch C is closed for a short time immediately before the discharge slat conveyer is set in motion. If all six cakes have dumped properly the normally closed contacts in switches A will be open when switch C is closed, and the operation of the machine will not be interrupted. If, however, any cake or cakes fail to dump, one or more of the switches A will be closed when switch C is closed, and the relay system F will be energized. This will sound the alarm and actuate the valve on the air cylinder, the plunger of which is connected to the main clutch on the machine. Thus the machine is stopped. The reset is operated manually, and it locks in place, silencing the alarm and releasing the air pressure in the cylinder. The operator then has manual control over the main clutch and starts the machine after the malfunction has been corrected. As soon as the machine is started, arm D moves away from switch C which then opens and allows the relay system F to return to normal.

It is of interest to note that a wax cake may fail to dump in a number of ways, two of which are shown by dotted lines in Fig. 4. If the trailing edge of the cake sticks in the pan, the corresponding switch will not be operated and the alarm will function. If the leading edge of the cake sticks in the pan, the trailing edge will drop down and operate the switch, thus signaling that the cake has dumped. However, the pan continues to move to the right and will drag the cake away from the switch arm during the interval of time that switch C is closed, thus causing the alarm to operate.

The discharge slat conveyer, which operates intermittently to move the groups of six wax cakes out of the machine and onto a continuously moving conveyer, and the continuously moving conveyer itself were originally driven from a gear case which received driving power from the main drive system. This transmission system consisted of a combination of gear-and-chain drives with a clutch to provide intermittent motion to the slat conveyer and required considerable maintenance. Several failures occurred, probably caused by high loads imposed in starting the slat conveyer. This driving system was replaced with an independent motor-driven gear case of a more rigid design which has proved to be satisfactory.

The original tin-coated plain steel slats in the slat conveyer required renewal after approximately $2^1/_2$ years. The coating failed as a result of abrasion caused by the wax, and the slats themselves deflected and took a permanent set due to the loads imposed on them. They were renewed with slats fabricated from Type 304 stainless steel and stiffened by the addition of a web welded to the underside of each.

The mold pans, also originally tin-coated plain steel, began to show signs of failure after approximately 8 months of service. The tin coating failed in an area of the inside bottom which was subjected to the stream of molten wax when filling. It is believed that thermal shock caused the failures. All 2508 pans have been renewed with pans fabricated from Type 302 stainless steel.

The pan heaters which heat the pans during their passage from the dumping station to the filling position, Fig. 1, were subjected to wax deposits falling out of the pans and off the slat conveyer. These were electric radiant sheathed-element heaters, and the reflectors became blackened by the wax deposits. The heaters were renewed and the design was modified to incorporate stripheating elements enclosed in reflectors which are formed in steps to prevent the accumulation of wax.

Some difficulty has been experienced with the depositor valves. These consist of a cast-iron block and a steel piston. Passages are provided in the block and the piston, the piston being rotated to align one set of passages while the depositor is being filled and another set when the wax is discharged into the pan. These parts require very close fits, and any wear would allow wax to by-pass or spill and destroy the accuracy of the cake weights. Failure has been experienced as a result of galling. As a temporary expedient the pistons have been undercut, built up with alloy weld metal, and remachined. Consideration is being given to renewing the parts with corrosion-resistant nongalling material.

ROUTINE MAINTENANCE

It has been found that the equipment requires the full-time services of a machinist trainee for maintenance purposes. Cleaning and lubricating parts and renewing small parts are the primary maintenance procedures.

A considerable amount of manpower is consumed in maintaining the gluing equipment, the condition being aggravated by the fact that the cartons are glued with waterproof glue. It is necessary to clean the glue machine thoroughly at the end of each shift since the glue becomes very hard and abrasive upon drying. Items such as glue rolls, scrapers, and glue-pump parts have a limited life owing to the abrasiveness of the glue. Some investigation has been made into the possibility of coating such parts with a material such as Teflon, and also into the possibility of modifying the machine to eliminate as many moving parts as possible.

CONCLUSION

It is believed that the new continuous wax-molding system, although still in the process of development, constitutes a substantial advance over the old plate-and-frame batch-molding process. The new machine has a capacity of 1785 lb of wax per manhour compared to 466 lb per manhour with the old process, and the following additional advantages have been obtained: (1) Decreased cost of molding wax; (2) increase in wax-molding capacity; (3) improved appearance and cleanliness of wax cakes; (4) more uniform cake weights.

ACKNOWLEDGMENT

The author wishes to express his appreciation to his colleagues at Magnolia who assisted in the preparation of this paper, and to the Magnolia Petroleum Company for permission to prepare and publish it.

Position of the TECHNICAL PRESS *in Relation to* INDUSTRY

By J. FOSTER PETREE

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OF THE many memorial lectures which are delivered periodically to the members of professional engineering societies, very few are associated with the names of the Secretaries to whom, in the aggregate, those members owe so much. The commemorative significance of this tribute to Calvin Winsor Rice will increase year by year as the proportion of the members of the Society who were personally acquainted with him inevitably diminishes. For this reason I count myself highly honored to be selected as one of those privileged to recall him to members of this Society.

It was not my good fortune ever to meet Dr. Rice, though he was in England on a number of occasions; but his name was familiar enough to me, for, during the period that I served on the Council of The Institution of Mechanical Engineers—the last four years, as they proved, of his energetic and fruitful life—it was remarkable how often his name came up in the course of our meetings. Rice was, indeed, an international figure, in his activities and his interests; for example, it was he who instigated the placing of the memorial window to Lord Kelvin in Westminster Abbey.

In his address at this meeting of the Society the President said that an engineer must be half practical, half dreamer. Rice certainly conformed to that specification. His feet were firmly on the ground, but he had the vision to see that only by close co-operation among the societies, of all nations, which exist to promote the advancement of engineering, could engineering attain to the dignity of a science and develop that true characteristic of a science, that it "knows no frontiers." So far was he successful that his tragically sudden death, on October 2, 1934, probably induced a more widespread sense of personal loss than that of any previous secretary of an engineering society.

The fine tribute that was paid to him by Dr. Karl T. Compton, President of the Massachusetts Institute of Technology, when, in 1931, Rice was made an honorary member of this Society, and which was quoted in his obituary notice in MECHANICAL ENGINEERING only three years later, cited four principles that "were basic to Dr. Rice's philosophy of Society organization and operation," namely, unselfish co-operation with related societies, active planning for the future, "giving the most effective service to the members of the profession," and "leading the profession in rendering the most valuable possible service to society." There is a good deal in common between the functions and the daily problems of an institution secretary and those of the editor of a technical journal, and the third and fourth of the principles I have quoted, if to "profession" be added "and industry," indicate that parallelism sufficiently closely, perhaps, to justify me in offering on this occasion, a few reflections on the position of the technical Press in relation to industry.

The Calvin W. Rice Lecture, presented at the Fall Meeting, Rochester, N. Y., October 5–7, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

WHAT IS THE TECHNICAL PRESS?

There is a legend that a new periodical once appeared in which the initial leading article announced, with refreshing candor, that "This journal has been established to meet a long-felt want, namely, a comfortable competence for the proprietor." Almost certainly, it was not a technical journal. . . . they deal with practical men and do not need to labor the obvious; but it is sometimes a little difficult to convince the readership of a technical journal, especially one with a circulation that is largely industrial or commercial, that financial considerations may not be the sole motive governing its contents, its expressed opinions, or, on occasion, its omissions. This should be evident enough from the elementary fact that, while it is possible to run a paper that has readers but no advertisers, it would be quite impracticable to maintain one that had advertisers but no readers.

This is fundamental, but it is not always appreciated; though it must be admitted that, in the case of technical periodicals more than most, the problem of ascertaining and evaluating the relative positions of the reader, the advertiser, and the scientific, professional, and industrial publics which are their background is one of considerable complication, made still more complex by the economic trends of recent years.

There can be few publishers or editors of long-established technical journals who, turning over the pages of their earlier volumes, have not envied the relative simplicity of technical publishing as their predecessors knew it, even a mere half century ago. Those halcyon days have gone, never to return, but it is permissible to wonder whether the changing circumstances are really understood as widely as they might be; and indeed, whether the functions that the technical Press can and should exercise are properly appreciated by those who ought to benefit most by them.

In the first place, however, how is one to define the "technical" Press as distinct from the scientific and the frankly "trade"? Comparison with the world of newspaper and magazine publishing is of little help, for that is a different field altogether; it is possible, perhaps, for a newspaper man to learn to pull his weight on a trade paper, especially one dealing with consumer goods, but he would be hopelessly at sea if he joined the editorial staff of a scientific or technical publication. The pure scientist or mathematician would also find himself at a loss, though to a less extent, in the field of the technical journalist, who must have a firsthand acquaintance with industrial affairs as well as with technology.

My own definition of a technical journal is one that maintains an editorial staff of men whose training has been primarily technical and who are competent to discuss with their readers and contributors, on reasonably equal terms, the technicalities of the field with which the journal purports to deal; and—this is important—that it should be in a position to take an independent line on matters of technical controversy, without

regard to purely commercial influences. This last is often a hard condition to meet, but a reputation of that sort is an asset not to be relinquished lightly.

The definition or yardstick that I have given has no official backing from any publishers' association or other authority; it is a purely personal attempt to lay down a line of general demarcation. I am well aware that it is less precise than might be desired; but precision in this matter is peculiarly difficult of attainment, because many periodicals do not fall definitely into one category or another, and there are even some which appear to fluctuate in their allegiance at different periods. Many engineers, however, seem to have such a vague notion of what they mean when they refer to the technical or trade Press that the broad division I have suggested may serve to clarify their ideas.

FUNCTIONS OF THE TECHNICAL PRESS

In considering the present and future position of the technical Press in relation to industry, it is desirable first to consider what functions a technical journal should discharge. Those functions may be classified under a number of main heads, which vary in their order of importance in different cases and circumstances. They are those of (*a*) presenting current news of technical progress; (*b*) reporting events of technical interest; (*c*) sifting (and often discovering and translating) reports of such progress in foreign publications; (*d*) reviewing technical books; (*e*) providing informed comment, and the opportunity for readers to comment also, and thus helping to mold technical opinion; and (*f*) providing advice and special information when this is asked for. The manner in which these functions are discharged naturally varies between one function and another, according to the facilities available; and between one publication and another, according to the order of precedence in which, in the judgment of those who conduct the journal, the several functions should be placed. Moreover, the changing pattern of the engineering profession and industry, in the course of years, may lead to a gradual shifting of the emphasis. For example, the journals of 50 years ago printed countless letters and queries from readers, to which no editor of the present day could afford to devote a corresponding amount of space; yet he might feel justified in filling that space with expensively produced illustrations, even though their presence might not be essential to the accompanying text, because that is what the reader of today expects and (often illogically) desires.

A SOURCE OF EDUCATION TO THE ENGINEER

Broadly speaking, therefore, it may be said that the main function of the technical Press is educative—that of making available to the engineer, as widely as possible and with due discrimination, the experience of others in his own and related fields, the related fields being particularly important at the present time, when developments in one direction, such as metallurgy or electronics, may be the key to advances in many others. Engineers, after all, learn their art and science almost entirely by experience—their own, that of their predecessors, and that of their contemporaries. Of the utility to a man of his own experience I need not speak. The experience of his predecessors is largely, though not wholly, available to him in the appropriate textbooks; but the textbooks cannot begin to present to him, on any comprehensive scale, the most recent experience and the hopes, ideas, ideals, deductions, and sometimes fanciful notions of his contemporaries, which may have such a valuable formative effect on the development of his own thoughts and ambitions. For information of that kind, he must rely on the periodical literature of his subject, comprising the published transactions of societies such as this, the reports of organized research, and the technical Press. To many men, working in places far removed from libraries and institutions, the technical Press is their accepted guide to the other two.

In the nature of things, textbooks are always out of date to some extent, if only that of the time needed to prepare and produce them, and the absolute impossibility of revising them quickly enough to keep pace with the growth of knowledge. Books which deal with basic principles can be relied upon to retain some permanent value, but their presentation may be obsolescent even if their fundamental matter is not. In any case, however, books of this kind, while essential to the student, are not so much used by the engineer in his later and really productive years; what he needs are the results of actual practice, and for that he must go to the periodical literature—which, indeed, is one of the main sources from which new textbooks are compiled, as may be seen from the long lists of references usually to be found in them. Parenthetically, it may be remarked that a spell on the editorial staff of a technical journal, to be spent in extracting and condensing the essentials of these learned dissertations, might be of considerable benefit to those who contemplate adding to their number.

REACHING INDUSTRY THROUGH THE INDIVIDUAL

My subject, I am aware, is the position of the technical Press in relation to industry, whereas hitherto I have discussed rather its value to the individual; but an industry consists of individuals and what it thinks and does as a whole is, after all, merely an integration (or, perhaps, a reflection) of the thoughts and acts of a comparatively small number of its component personnel. In what follows I would address myself rather more directly to the individual reader, and ask him what is his attitude toward the technical Press; whether he is getting out of it all that he requires, and that it has to offer; and whether he is not rather inclined to take it for granted, as one does a daily newspaper, without stopping to consider that it needs his interest and co-operation—and that not solely in the renting of advertising space. The principle of the conservation of energy has its analogues in many other directions, and what a man gets out of the technical Press must depend to a very great extent on what he, as representing the engineering and associated industries, puts into it.

The reader will need no instruction from me, as a practical economist—and all engineers are that—on the difference between "value" and "price." Price may be fixed, usually by the seller; value may fluctuate widely and depends mainly on the buyer. Price can be standardized and regulated, but value is a matter of personal opinion and sometimes individual whim, depending upon such intangibles as interpretation, present or future utility, and even sheer sentiment. What I want to emphasize is that value depends much more upon the valuer than upon the thing that is valued; and the value of the technical Press to engineers is a function of the use that they make of it, the knowledge that they bring to their reading, and their capacity to appreciate the variety and quality of the vast stores of technical information and critical comment that are contained in its pages. It may seem, at times, to be in competition with the publications of the learned societies, but in fact that is not so; it is complementary to them, and a careful study of both is necessary if a true picture is to be obtained of the complex intermingling of science and practice that is the engineering industry of today.

If engineers, and industrialists, set themselves to consider what they really want from the technical Press, I am confident that each and every one will arrive at the same conclusion.

He wants facts; and if he is candid with himself, he will admit that it matters very little whether they are presented in plain black and white or with all the splashes of color and the artful typography that tends today to overflow from the advertising pages into the editorial text. Perhaps I am old-fashioned in this and some other respects; but I cannot help observing that the professional societies, which expect their publications to be taken seriously, and read conscientiously, do not employ these costly eye-catching devices, or accept the advertising man's favorite argument that the top-ranking executive has no time to read columns of type, but must be enabled to grasp the whole story in a flash by merely flipping over the pages and glancing at the headings and the illustrations. My counter-argument is that the top-ranking executive probably doesn't read the advertisements either; but, if he knows his job, he will have people on his pay roll who read the whole issue from cover to cover, knowledgeably and critically. It is to these men that he will turn when he wants a specific answer to some technical question, and it is to them that the editorial matter should be primarily addressed.

These are the people who seek out the facts, to present them in the proper quarter at the right time. But an editor cannot invent facts; he can only examine, appraise, compare, arrange and, as may seem desirable, emphasize them. (Chambers' Twentieth Century Dictionary puts the editorial function rather differently, defining the verb "to edit" as "to compile, garble or cook up materials into literary shape"; but that is just a question of the point of view.) It is obviously desirable, therefore, that the editor should be able to meet directly the executive heads of the firms and organizations in his particular field, whenever he has occasion to do so. As a general rule, he can and does; but that is not enough. It is eminently desirable also that those executives, technical and administrative alike, should appreciate what he requires and, busy men though they are, should be prepared to devote some personal attention to ensuring that he gets the facts that he is seeking.

INDUSTRY'S RELATION TO THE PRESS

With the growth of big scientific and industrial organizations, and the wide spread of their activities, that is becoming steadily more difficult to ensure. Hence has developed the modern tendency to lump together all Press matters, editorial as well as advertising, under the general heading of "publicity" and to hand them over to a middleman, either a member of the firm's staff or an outside advertising agent. In the former case, this may work smoothly enough, especially if the staff man is technically trained, is of sufficient standing within the firm to have ready access to everyone who matters, and has the requisite knowledge of technical journalism to realize what is wanted and that what may serve for one journal may not suit another. Where those conditions are not satisfied, however, he may, with the best intentions in the world, become a barrier to effective liaison; or, worse still, come to regard himself, and to be regarded by his superiors, as having been put there as a barrier, to protect them against the importunities of too-pertinacious Press men. Too often, also, the outside man, whose interests probably lie mainly in the buying and filling of advertising space, is liable either to become a mere "post office," relaying queries to his client and transmitting their replies, or else to concentrate on obtaining the maximum number of "mentions," without much regard to their technical worth. There are notable exceptions, to whom I gladly pay tribute, and they flourish deservedly; but, in almost every instance, they are men who have had a technical training in the first place.

I am confident, therefore, that I am expressing the views of technical editors, in general, in suggesting that the heads of engineering firms, and of scientific and research organizations, would do well to consider the advisability of separating purely advertising activities from the direct distribution of technical information, of devoting some part of their time to personal collaboration with the editorial departments of the particular journals interested in their work and products, and of assisting the editors of those publications to make them sources of permanent reference value that the readers—I mean the serious readers—will want to file.

INDUSTRY SUPPORT NEEDED

The textbooks and the transactions of the learned societies cannot possibly record all the developments that are taking place today; and, in any case, they are often "preaching to the converted." Moreover, modern economic conditions make it increasingly difficult for ordinary men—especially the younger men, from whose ranks must be drawn the executives of tomorrow—to acquire and retain all the published books and papers relating to their particular branches of engineering. Hitherto, the technical Press has gone far to meet that disability, to fill gaps in the records of technical achievement, and, not seldom, to promote further advances; but it can only continue to do so if its functions are properly appreciated at all levels and are accorded the necessary support. Given that support—"not grudgingly or of necessity," but with the real confidence and even enthusiasm of those who direct both the administrative and the technical sides of industry—it can be of even greater value to both designer and producer in the future than it has been in the past.

Far be it from me to belittle the advertising aspects—printing and other costs are at such a level today that no technical journal could be produced without the financial aid that the advertising pages represent, unless at such a price that few men could afford to pay; but I repeat, and do most emphatically maintain, that the prime function of the technical Press must be educational in the truest and widest sense of that sometimes misapplied word. If that aim is kept constantly in view, by the readers, the contributors, and the advertisers, as well as by those who conduct the journals, the other desired benefits will follow, to profession and industry alike. If it is not, I can only feel that, in the long run, the industry will be the loser. With such aid, the English speaking peoples in particular have built up a fund of practical knowledge that is an immense asset. Whether its potentialities are realized or not depends entirely on the user.

CONCLUSION

I am grateful for this opportunity to express these few personal views on a subject which has been the constant companion of my thoughts for a considerable number of years. I have only skimmed the surface of it, but perhaps I have said enough to set some few of my readers wondering whether, after all, there is not something more in this technical Press business, of direct concern to themselves, than they had previously recognized. To change the metaphor, the Council of the Society gave the initial impulse; I constitute the relay. It is for each reader, individually, to provide such degrees of amplification as may suit his personal needs and purposes. He may be assured, however, that in anything that will make for progress in engineering the technical Press will continue to stand as a good friend of industry.

Why PRESTRESSED CONCRETE *in the* REFINERY

By J. S. BELL and D. R. DEVEAUX

ESSO STANDARD OIL COMPANY, BAYWAY REFINERY, LINDEN, N. J.

MAINTENANCE costs in most refineries could be slashed materially by the use of concrete construction. However, small use has been made of concrete because of one inherent disadvantage—it cracks under negligible tensile stresses.

This deficiency has been overcome partially through use of steel reinforcing rods embedded in the concrete. While most industries have been satisfied with this type of concrete, those which deal in the storage and movement of liquids have not, simply because the concrete will still crack. These are small cracks in most cases, but unfortunately not small enough to prevent loss of valuable hydrocarbons.

Prestressing concrete is a simple means of eliminating this drawback of concrete in construction. It is the intent of this paper to underline the basic principles of prestressed concrete and to show the advantages and importance of this material to the petroleum industry.

BASIC PRINCIPLES

The main concept of prestressing consists of precompressing the concrete to such an extent that, under given design conditions, no tensile stress will be developed. The idea itself is much older than concrete—perhaps dating back to the human who first reinforced a wooden wheel with a steel hoop.

Normal Reinforced Concrete. To visualize the effect of prestressing, let us first examine a simple reinforced-concrete beam. There are two noteworthy facts to be considered in Fig. 1. Upon examining the stress diagram, note that all the concrete on the tension side of the neutral axis is useless from a design standpoint. It serves only to transmit the tensile stresses to the reinforcing steel, and, of course, it joins the steel and the compressed concrete. In prestressed concrete, as we shall see, all the concrete is stressed and considerable concrete is saved. The second point follows directly from the first. There cannot be stress without deformation so that in order to transmit tension to the steel, the concrete is deformed—and cracks. In conventional concrete design the steel is not permitted to take its full stress capacity because the concrete would crack excessively. Prestressed design, by eliminating this problem, reduces the amount of steel required.

Prestressed Concrete. In most concrete construction, tension cracks are not troublesome, but, as mentioned earlier, petroleum tankage and lines cannot tolerate even the smallest crack. Fig. 2 shows how a prestressed concrete beam will perform under a similar load. By initially compressing the beam longitudinally, enough compressive stress has been introduced so that, up to the design load, no part of the beam is in tension. Under these conditions no cracks can be formed. Note, too, that the cross section of the beam has been reduced because there is no material needed in excess of that actually carrying load. In addition, the longitudinal prestress reduces diagonal tension stresses, which allows a smaller section.

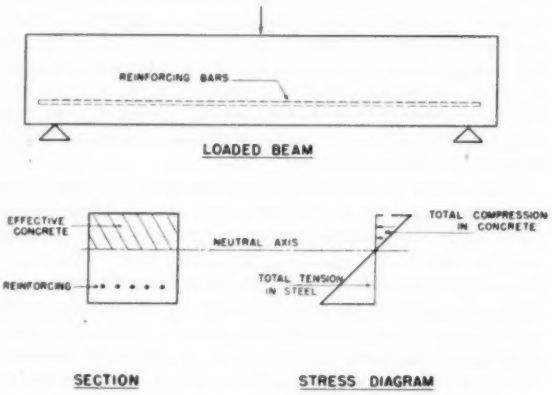

FIG. 1 SIMPLE REINFORCED-CONCRETE BEAM

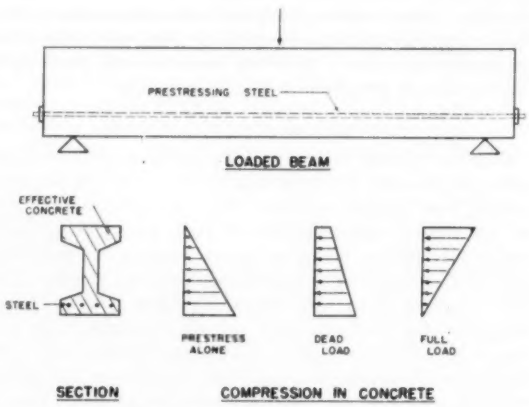

FIG. 2 PRESTRESSED-CONCRETE BEAM

Design Savings. The effect of these design savings can be seen in Table 1, which compares concrete and steel requirements for tanks designed by the Preload Company, Incorporated, with conventional concrete tanks. In most cases it can be assumed that one half of the concrete and two thirds of the steel required for a reinforced-concrete tank and up to 85 per cent of the steel required for a steel tank can be saved through prestressing.

DEVELOPMENT

In early stages of development, prestressing faced a serious obstacle. Designers noticed that the concrete in certain struc-

Contributed by the Petroleum Division and presented at the Petroleum Mechanical Engineering Conference, Houston, Texas, September 28–30, 1953, of The American Society of Mechanical Engineers.

TABLE 1 QUANTITY COMPARISON—CONVENTIONAL VERSUS PRELOAD

HUNTS POINT SEWAGE TREATMENT PLANT, BRONX, NEW YORK				8 TANKS	
ITEM	UNIT	CONVENTIONAL DESIGN	PRELOAD DESIGN	SAVING	% SAV.
CONCRETE	C.Y.	17,840	11,060	6,780	38%
STEEL	TON	1,642	474	1,168	72%
NORTH EAST TREATMENT WORKS, PHILADELPHIA, PENNSYLVANIA				8 TANKS	
ITEM	UNIT	CONVENTIONAL DESIGN	PRELOAD DESIGN	SAVING	% SAV
CONCRETE	C.Y.	18,800	12,080	6,720	36%
STEEL	TON	2,300	910	1,390	60%
HYPERION SEWAGE TREATMENT WORKS, LOS ANGELES, CALIFORNIA				18 TANKS	
ITEM	UNIT	CONVENTIONAL DESIGN	PRELOAD DESIGN	SAVING	% SAV
CONCRETE	C.Y.	24,550	12,890	11,660	46%
STEEL	TON	2,510	561	1,949	78%
OWLS HEAD SEWAGE TREATMENT PLANT, BROOKLYN, NEW YORK				8 TANKS	
ITEM	UNIT	CONVENTIONAL DESIGN	PRELOAD DESIGN	SAVING	% SAV
CONCRETE	C.Y.	8,824	4,741	4,083	46%
STEEL	TON	904	275	629	70%

tures appeared to lose most of its prestress. This was most apparent in newly built tanks which, when first emptied of their contents, began to crack. These developments finally were isolated to the following factors: Creep in the tensioning steel and shrinkage and plastic flow in the concrete. The Massachusetts Institute of Technology in this country and other groups in France, England, Switzerland, and Belgium conducted studies during the 1940's to determine the magnitude and characteristics of these factors.

It was determined that the stress loss, regardless of initial stress, could amount to as much as 40,000 psi. Since early pre-stressing operations made use of intermediate-grade steel, stressed by turnbuckles to 18,000 psi, it is easy to see why results were not favorable. Higher-grade steel, which could be stressed safely to 50,000 psi, was developed subsequently but the problem remained mostly unsolved.

Recently, methods have been evolved for using both high-strength steel wire and steel rods at stresses of up to 150,000 psi. At this design stress nearly 75 per cent of the capacity of the steel can be used to resist external moments.

Inasmuch as the refiner can most readily utilize prestressed concrete for tankage, construction methods will now be discussed.

CONSTRUCTION METHODS

It is unfortunate that most prestressed tanks in refinery service today were constructed of the lower-grade steels just mentioned and stressed by turnbuckles. In many cases these tanks have given little better service than conventional concrete tanks owing to the loss of compression in the concrete. Prestressed tanks built by the latest methods have largely eliminated these difficulties.

Foundation. Fig. 3 shows a typical design for relatively unstable soil conditions. Foundations may be either piling or of the ringwall type, as shown. While it is normally not economical to build the foundation wall more than 25 ft deep, the use of piles requires a more expensive floor. The average floor itself consists of a thin flexible slab enclosed by a ring under the tank shell. The use of this thin floor is possible only if the subgrade is a clay or sandy soil. The floors are usually 2 in. of pneumatic mortar with 0.5 per cent reinforcing steel each way. The joint between shell and floor is a fixed type for small tanks and a sliding type for larger ones in order to reduce moments in the shell.

Shell. The shell may be constructed with normal wood

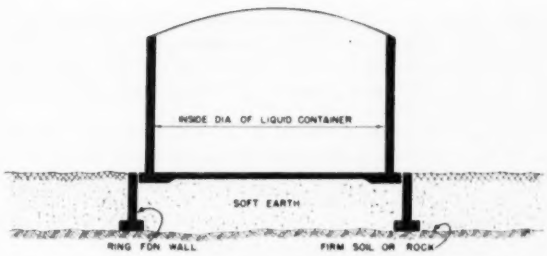

FIG. 3 TYPICAL FOUNDATION DESIGN

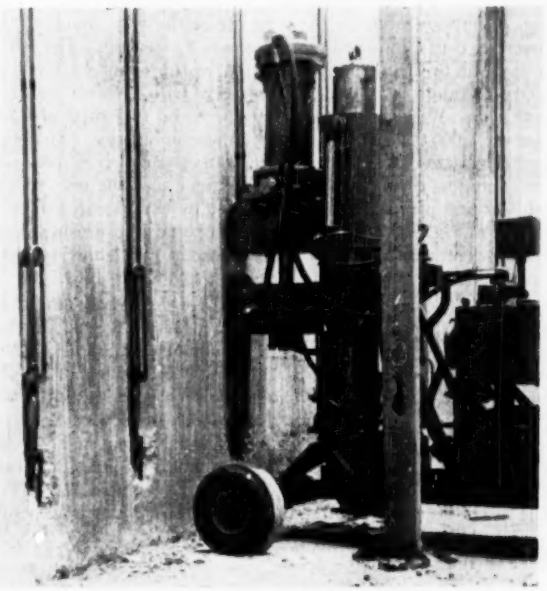

FIG. 4 VERTICAL PRESTRESSING

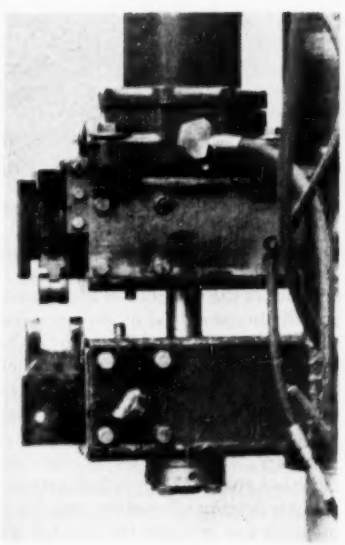

FIG. 5 HYDRAULIC JACK

forms. However, if the tank is to be in variable stock or light hydrocarbon service, it may be advantageous to use a steel inclave lining as the inner form. This leaves a surface which can be cleaned easily and prevents percolation of light stocks through the concrete.

To overcome bursting stresses in the wall caused by restraint at the base, vertical prestressing is applied to the cured shell. This is done by wires placed in a prepared key, as shown in Fig. 4. Details of the hydraulic jack used are shown in Fig. 5. After the wires are stressed, the keys are filled with mortar and the shell is ready for horizontal prestressing.

Winding Operation. Horizontal prestress is applied by winding a wire around the cured concrete shell. For wire winding the Preload Corporation has designed a self-propelled machine known as the merry-go-round. This machine, shown in Fig. 6, imparts stress to the wire before the wire touches the concrete, thus eliminating losses caused by friction. The wire is stressed by being passed through a die. Support for the merry-go-round is provided by wheels which travel on the tank rim. Wire can be placed at speeds up to 7 mph and an average 1,000,000-gal tank can be wound in 2 days. At some points adjacent rings of wire are clamped together to prevent complete loss of the winding in the event that the wire snaps while being placed. Splices are made by the patented device shown in Fig. 7. When the winding operation is finished, the steel is protected from corrosion and injury by a guniting-type operation.

Dome. The dome is poured before the merry-go-round applies horizontal prestressing to the shell. Forms for the dome are shown in Fig. 8. They consist of a standard wooden rib construction supported by columns. To the left of the illustration can be seen wood sheeting which is nailed to the rib construction. These domes are completely unsupported except at the ring. They consist of pneumatic mortar or concrete reinforced with wire mesh. The thickness of the dome can vary from 2 to 6 in. After the dome has been placed and cured, the merry-go-round applies the horizontal prestressing to the shell and several rings of wire are wound around the perimeter of the dome. This causes the dome to be compressed and, as evidence of the efficiency of the operation, the dome can be seen actually to rise several inches above its formwork.

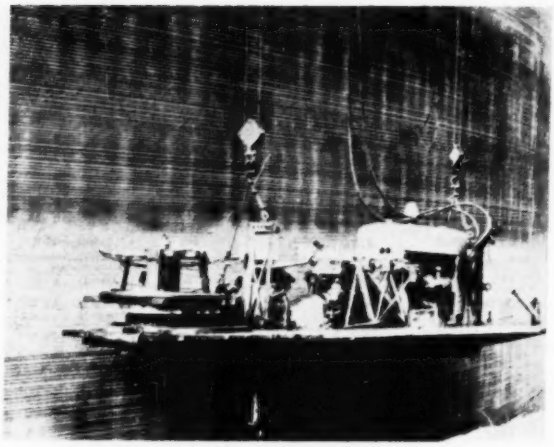

FIG. 6 "MERRY-GO-ROUND"

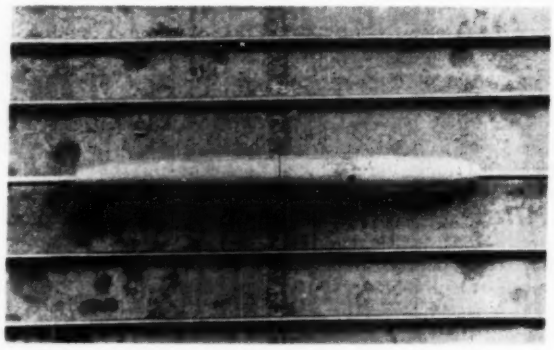

FIG. 7 WIRE SPLICE

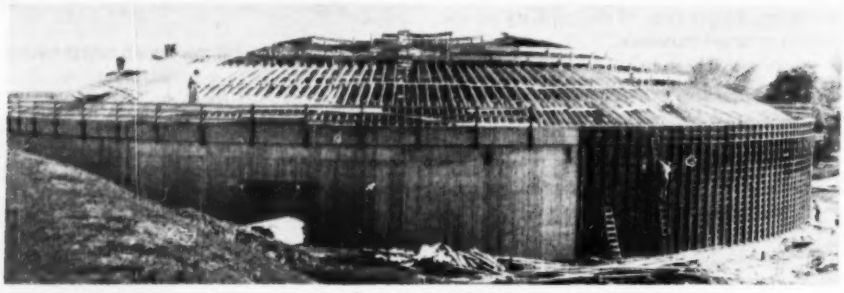

FIG. 8 DOME FORMWORK

These domes can be designed to withstand heavy concentrated loads at their center or to take a uniform load of fill above them. There have been instances of nominally designed domes taking the load of a truck accidentally driven across the surface.

Linings. The problem of suitable linings for prestressed tanks is twofold; i.e., contamination of the lighter stocks, and possible deterioration of the concrete itself. Aviation gasoline in particular presents the greatest problem since it contains toluene, zylene, and benzene which will react with free alkali in the concrete.

The United States Navy in its specifications for prestressed tanks prepared the following list of linings which it has found satisfactory for the various services: (*a*) Fuel-oil service, four coats sodium silicate applied by mops, hairbrooms, or spray; (*b*) diesel-oil service, an inert resin-base enamel applied over a prime coat and covered with a double seal, all applied by spray; (*c*) aviation-gasoline service, an organic polysulphide applied by spray or in prefabricated sheets. At the present time, the Preload Company recommends the inclave steel lining mentioned earlier. This can be constructed at a relatively low cost and prevents deterioration of the product and also eliminates

percolation through the concrete. Other linings developed to date include various types of vinyl linings which, while they serve the purpose, are generally too expensive to be justified.

While the linings mentioned, particularly the inclave steel lining, are apparently satisfactory for the storage of light stocks, it appears that more development will be necessary to permit economical storage of these stocks and easy transfer from light to heavy-stock service. As the interest in concrete tankage grows, it is to be expected that progress will quicken in the field of linings.

USE TO THE REFINER

In the past 25 years, there have been approximately 700 prestressed-concrete tanks constructed, with a total capacity of more than 11,000,000 bbl. These tanks have been used to store many different liquids including crude, gasoline, water, various chemicals, acids, sewage, and pulp. These tanks in most instances have performed satisfactorily under many varied conditions. Now let us examine in some detail the advantages and disadvantages of prestressed construction.

Material Saving. During recent years it has been brought home forcibly to the petroleum industry, as well as to industry in general, that steel in various shapes and forms is not always in ready supply. Delays in obtaining steel for tankage often have been a matter of months or even years and, therefore, the substitution of prestressed-concrete tanks could be of utmost importance. As mentioned earlier, a prestressed tank normally would require only $^1/_5$ of the steel that would be used in a similar steel tank. Regardless of the size of the unit involved, the saving in steel is quite appreciable. Add to this the fact that the special high-strength wire used for both the circumferential and vertical prestressing of tank walls is generally available, and we have a balance heavily in favor of the prestressed tank.

Land-Saving Adaptability. Because of the corrosive nature of steel tankage and the general fire hazards involved, steel tankage must be spaced at certain intervals. Furthermore, it is difficult to use steel tankage in underground installations. Prestressed tankage does not follow in this same pattern. Being relatively free from corrosion, the prestressed tanks may be placed at any level suitable for refinery operation. In fact, it is possible to place tanks one upon another to utilize to the fullest extent the land area available for tankage. To date, approximately 50 prestressed-concrete tanks have been constructed for underground storage of crude or gasoline. The performance of these tanks has been generally satisfactory.

In regard to above-ground land-saving uses, this feature is closely allied with the general fire-resistant qualities of prestressed-concrete tanks and will be discussed at greater length in the section devoted to the fireproof features of prestressed tanks. However, it should be emphasized that, in refineries where there is a shortage of available storage areas, the use of prestressed-concrete tanks could conceivably more than double the available capacity for oil movement and storage.

Shock-Resistant Qualities. Approximately 50 prestressed-concrete tanks have been constructed in what is normally considered the North American earthquake area. Naturally, these tanks would not be expected to withstand a direct fissure very near or beneath them. However, through adequate design which considers the possibilities of earth tremors, prestressed tanks can be adequately constructed for general use. In addition, these tanks are considerably safer to adjacent tankage in the event of a fire and subsequent explosion. All of this perhaps is emphasized more by the fact that the military are presently considering the construction of a large prestressed tank to test mines. This tank normally would be expected to withstand the shock delivered by the underwater or surface explosions resulting from tests of the mines. Such a tank can be designed easily.

Fire-Resistant Qualities. Steel tankage, depending upon the type of hydrocarbon storage involved, requires certain spacing of units together with adequate fire-wall protection. For comparable prestressed-concrete tankage, it is believed that similar firewall protection would be necessary, primarily to handle spillage and accompanying fire from interconnecting pipelines. However, in regard to spacing of units, it is felt that because of the inherent fireproof characteristics of concrete, adjacent tanks might be placed much closer, depending more upon maintenance requirements than upon fire-protection requirements. The prestressed tank, being an integral unit, logically should be considered as having little effect upon adjacent units. An internal tank fire certainly would not cause sudden and disastrous failure to the wall structure, such as would be expected in steel tanks. True, the wall structure might crack under the intense heat, particularly if water or foam or other fire-fighting liquids were played upon the exterior wall of the tank itself. However, these cracks probably would be of the hairline variety and while the tank itself conceivably might be ruined, there should be no danger to adjacent units.

Maintenance Factors. From a maintenance standpoint, let us take a practical example. Assume two tanks, one of prestressed concrete and one of nominal steel. Further assume that these tanks of 151,000 bbl capacity are to be located at the Bayway Refinery of the Esso Standard Oil Company, in the center of a critical labor market, low-load-bearing soils, high water table, and flat terrain. In the case of the steel tank, we will consider the life span to be approximately 30 years, and that for the concrete tank, to be approximately 60 years. (Many users consider a 60-year life span for a prestressed tank to be on the conservative side.) Based upon available figures of cost for comparable tankage in the Bayway area, it is estimated that the steel tank will cost approximately 90 cents per bbl or $136,000. This will include the foundations and the complete tank structure. For the concrete tank the first cost will be approximately $1.20 per bbl or a total of $181,000.

Now applying an interest rate of 4 per cent, let us compare annual costs of the tanks, assuming a salvage value on the steel tank of $5000. On this basis the annual cost for the steel tank will roughly equal $7760. For the concrete tank, comparable costs will approximate $8000 per year. Now consider the annual maintenance factors that are involved in each case. For example, at one refinery annual maintenance costs, including roof and shell repairs, painting and the like, have been equal to approximately $1500 per tank per year. This is based on 275 petroleum tanks with average capacity of 53,000 bbl. For tanks of 151,000 bbl capacity, an average maintenance figure of $2500 would be reasonable. Including maintenance, the total annual cost of the steel tank would therefore be $10,260.

Now let us examine the maintenance features involved in the concrete tank. There would be no corrosion problems and no painting problems and, assuming adequate design and construction, no repairs for cracks.

Including all possible incidentals, perhaps $100 per year would be spent for various small maintenance items. However, a conservative estimate of the hydrocarbon storage losses encountered as a result of disrepair of steel tankage would more than offset this maintenance charge (see "Conservation Factors"). Summarizing, we find that our final comparison of annual costs indicates that the concrete tank presents a figure of $8000 as against the steel tank cost of $10,260. This represents approximately a 20 per cent saving in favor of the concrete tank.

In the foregoing example we selected an area where the first cost of steel is well below prestressed-concrete tankage. If we had selected the Gulf area for our comparison, the unit price per barrel for the prestressed-concrete tank would have dropped to approximately 90 cents. Undoubtedly the price of the steel tank would have dropped somewhat below its Bayway figure of 90 cents per bbl, but the drop would have been much less pronounced. The large drop in cost of the prestressed-concrete tank is due primarily to the lower field-labor costs in the South. An estimate for the Gulf area indicates that the annual cost of capital investment for the steel tank would drop to about $8900 whereas the comparable cost for the concrete tank would drop to a low of $6000. This represents a saving of 30 per cent each year.

Conservation Factors. Steel-cone roof tanks today represent a source of considerable evaporation loss to the refinery in addition to contributing to the air-pollution problem. The field of evaporation losses from storage tanks was discussed at the 32nd Annual Meeting of the American Petroleum Institute and the findings of that group present a challenging picture. Using as an example the 151,000-bbl steel tank mentioned earlier, let us examine expected losses based on API recommended procedures.

Assume that the tank is 150 ft in diameter, 48 ft high, painted normally, and is used to store gasoline of 8 lb RVP at an annual average liquid temperature of 70 F. The API formula for these conditions indicates an annual breathing loss of 4600 bbl. At 10 cents per gal of gasoline, this amounts to $19,300 worth of finished product which each year is lost to the countryside.

The API conference further stated that such losses could be all but eliminated by the use of tanks capable of withstanding 2½ to 3 psi internal pressure. Although this solution is economically unfeasible in steel construction, a prestressed concrete tank of this strength can be built at a cost of about $1.40 per bbl. Such a tank would eliminate 95 per cent of the normal breathing losses and, therefore, save $18,300 per year.

Combining this saving with those of decreased maintenance and long life, the economic incentive becomes quite attractive. Again, based on 4 per cent interest rate, the annual cost of using the steel tank is approximately $29,500 compared to $9300 for that of the prestressed tank. The saving in original cost now jumps to about 70 per cent. Few refineries could afford to overlook such promising return.

Use as Sphere Replacement. Steel spheres now represent the only solution to the storage problems encountered with light high-vapor-pressure hydrocarbons. The great expense involved in this type of construction is well known to petroleum engineers.

While no installation exists, it is quite feasible that a prestressed-concrete design can be adapted to meet these high pressures. The design conceivably could take the form of a horizontal drum with an inverted dome at each end. Preliminary indications are that such construction could be accomplished for 5 to 7 dollars per barrel. This would be a saving of from 3 to 5 dollars per barrel over steel-sphere design.

Expanded Size Limitations. There is considerable evidence that steel tanks are approaching a size limitation based on present welding methods. While data understandably are difficult to procure, it seems certain that steel tanks should not be built larger than 250 ft in diameter without new techniques. Concrete tanks, on the contrary, already have been constructed to diameters of 320 ft. Since joints similar to steel welds are not required, the only restriction would seem to be the practical limitation of the winding operation.

THE PRINCIPAL DISADVANTAGES OF PRESTRESSED-CONCRETE TANKS

Lack of Versatility. Once a concrete tank is constructed, it must be considered immovable; it cannot be floated to another site and it cannot be dismantled for use at another site. Its salvage value is negligible. Therefore, it is conceivable that certain tanks, after 15 or 20 years, might suddenly become white elephants as a result of a change in operations. However, if care is exercised in selecting the use to be made of prestressed tankage this problem can be minimized.

Construction Difficulties. The evolution of the prestressed-concrete tank has been quite rapid but has been hampered considerably by the technical skill required. In addition, field-construction techniques are highly specialized and, therefore, labor problems are critical. This has led to longer erection periods than for comparable steel tankage and thus has increased capital investment required. Construction of prestressed-concrete tanks in extreme northern latitudes during winter months probably will remain a costly venture for some time to come. It is probable that as more prestressed tanks are constructed and more experience is gained, less time will be necessary to erect a prestressed tank. As in every new development, costs tend to decrease as more know-how is gained.

Repair Difficulties. Under normal conditions a prestressed tank should not crack. But, as "The best laid schemes o'mice an' men gang aft agley," prestressed tanks have been known to fail. Depending upon the extent of failure, repairs may be difficult to make. Hairline cracks can be reduced or eliminated by lining the tank with certain preparations. If the tank has very large cracks it may reasonably be considered a total loss. It should be noted however, that no concrete tank constructed with the relatively new wire-winding process has failed.

USES OTHER THAN FOR TANKAGE

Prestressed concrete has a place in the refinery in applications other than tankage. The warehouse shown in Fig. 9, constructed with prestressed-concrete beams, illustrates that wide storage areas with additional headroom may be made available through the use of prestressed-concrete design. This construc-

(*Continued on page 978*)

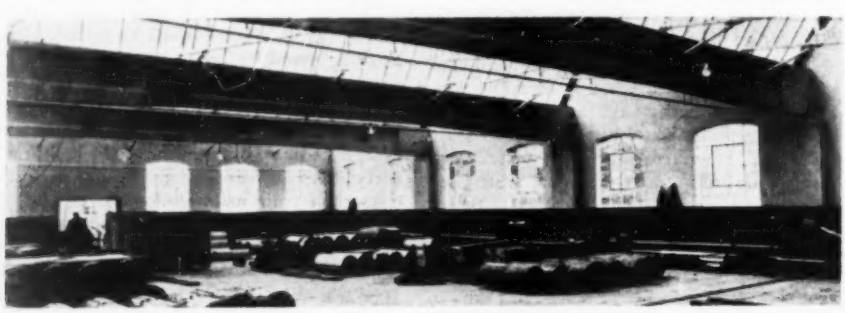

FIG. 9 WAREHOUSE

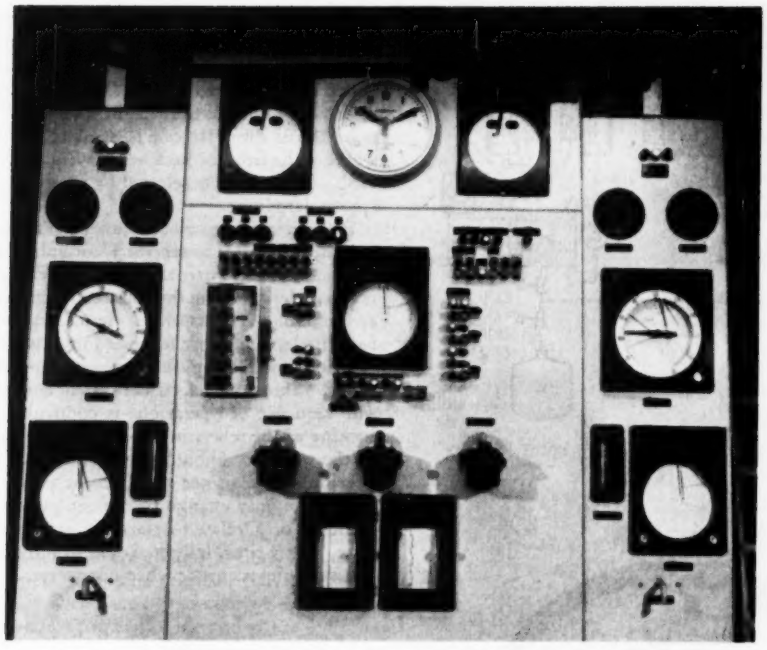

FIG. 1 CONTROL PANEL SHOWING SELECTOR SWITCHES, INDICATING LIGHTS, AND PROCESS-CONTROL AND RECORDING INSTRUMENTS FOR BATCH WEIGHING

Batch Weighing for Process Control

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REPETITIVE batch-weighing in a continuous process is an operation in which a flow of material is interrupted periodically to adjust the weight to some predetermined value. It differs from continuous weighing in that the continuous flow of material is separated into discrete quantities and weighed in static, single loads. As the unit quantities become smaller and their handling is accelerated through expert manual manipulation or automatic control, the effect can approach continuous flow. However, two features of batch weighing can be preserved:

1 The weight control may be more accurate.

2 The addition of different ingredients may be controlled more positively.

Such a repetitive batch-weighing system was installed in 1947 and now has operated through approximately 35,000 cycles. It constitutes an installation in which not only the design engineers and supplier are pleased with its performance, but also where the operating and maintenance personnel are completely satisfied.

OPERATION OF EQUIPMENT

Fig. 1 shows the control panel for the system. From this point an assortment of materials can be mixed in different proportions, with each ingredient added in exact amount and at the exact time to satisfy process conditions.

As shown in Fig. 2, the equipment consists of five scale tanks (1, 2, and so on) and suitable control equipment to blend five liquids, A, B, C, F, G, and two solids, D, E, in any desired proportions. Furthermore, selector switches are available to choose each specific component from any of several tanks, depending on the formula desired. Other controls also operate to prevent certain of the materials from being added unless the agitator is running and the fluid temperature has reached a desired minimum. Most of the ingredients are added, weighed, and controlled directly in the main weigh tanks 1 and 2. However, components D, E, and F are weighed and held in separate containers 3, 4, and 5, until process conditions are satisfied.

Fig. 3 shows the scale head for tank 1. Each pointer and the corresponding flag can be adjusted independently to provide three separate weight additions to the tank. During the first weighing period, the assembly rotates clockwise as weight is added until the first flag intercepts the light beam to the photocell. Filling of the second ingredient then begins until stopped by the second flag, and so on.

After setting his scales, the operator positions his selector switches to add the desired quantities of component A, B1, B2, B3, C, during the corresponding interval. Then he pushes the button.

A typical sequence of operations that might result, depending

Contributed by the Instruments and Regulators Division and presented at the Eighth National Instrument Conference, Chicago, Ill., September 21–25, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

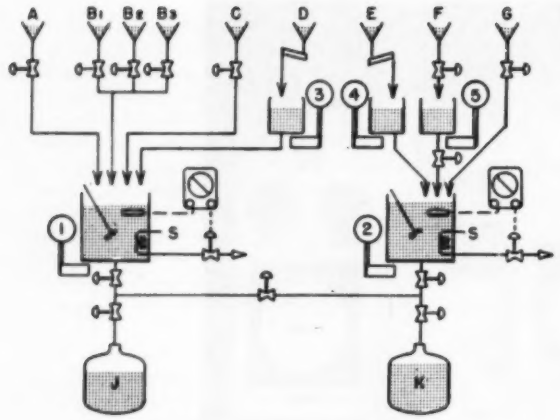

FIG. 2 SCHEMATIC ARRANGEMENT OF EQUIPMENT

FIG. 3 SCALE HEAD FOR TANK 1 SHOWING THREE ADJUSTABLE WEIGHT SETTINGS
(Flags adjusted to cut off each interval at any desired weight setting.)

on his settings, is illustrated in Fig. 4. After the selectors are set and the start button pushed, components C, D, E, F, and G immediately begin to fill tanks 1, 3, 4, 5, and 2, respectively. When C is completed, B is added to tank 1, followed by A. D discharges as soon as the weighing of A is completed. Signal lights indicate when each stage is active and completed. When the temperature reaches the desired control point a signal light indicates that tank 1 is ready, but it cannot be discharged until tank 2 is also ready and the operator pushes a release button.

Tank 2 is similarly controlled, except that the three ingredients E, F, and G are weighed simultaneously. When the weighing of all is completed, E and F are dumped together into tank 2, if process conditions are satisfied. The fluid is then heated to the control point, another set of lights comes on, and both hold tanks are ready to be dumped.

Fig. 3 shows three adjustable weight-control points on the front of the scale head for tank 1. These settings might correspond to formula J. There is also a second and completely separate set of weight-control points on the back of the scale head which might be set to another formula, K. Corresponding to these weight set points are three more selector switches which can be used to add any desired choice of components, A, B, or C, for each of the weight intervals. Thus either of the two desired formulas can be used at any time, depending on whether the front or back set of weight-control points is being used. The choice is selected by a switch and indicated by an appropriate light.

The electrical interlocks can be set so that formula J can only be dropped into reactor J, formula K only into K, or vice versa; or any alternate arrangement can be provided. On pushing the release button the material discharges into the appropriate reactor. The operator immediately can start another batch, selecting either formula J or K merely by setting a two-position switch and pushing a start button.

Fig. 5 shows the electrical system controlling the operation. The sequence of operations is controlled by the series interlocking of the relays in progression corresponding to each step of the process. Should power, material, or any other failure develop, the sequence starts at the point at which it left off. About the only change to the equipment as supplied was the addition of a relay to start the sequence over at the beginning, at any time, if desired, and to provide manual control of the weighing sequence when necessary.

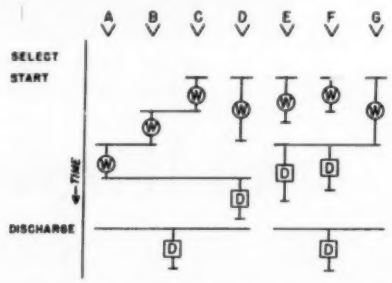

FIG. 4 SEQUENCE OF WEIGHING AND DISCHARGE OF DIFFERENT COMPONENTS

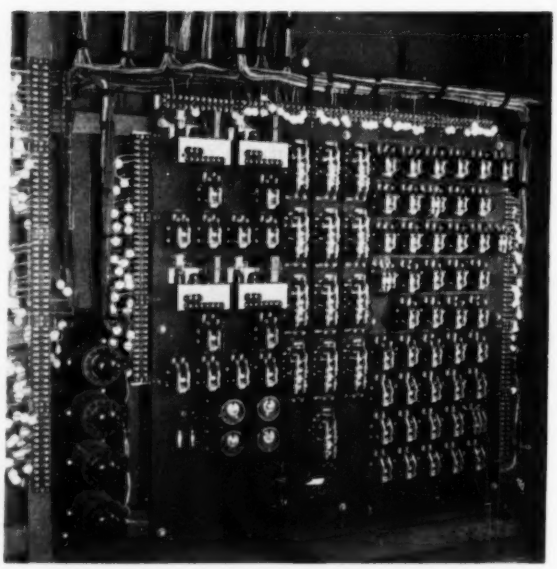

FIG. 5 ELECTRICAL CONTROL PANEL

Start-up was attended with some difficulty. It was necessary to learn the electrical system completely and to be able to recognize the stage of the weighing operation from the position of the relays. Eventually the key to the relay cabinet was given to a well-trained instrument mechanic and everyone else from plant manager down was instructed to keep out. This solved most of the troubles.

MAINTENANCE

Electrical maintenance consists of cleaning the relay contacts and checking the photocells and amplifiers once a month. As mechanical maintenance, the scales are disassembled annually for close inspection of all wearing parts. To insure that there will be complete freedom from mechanical troubles for the following 12 months, about one half of the bearings and pivots are replaced with new ones, and the remainder are reground and returned to service.

RESULTS

The equipment has been in continual operation for five years with excellent results. Repeated checks show no detectable change in accuracy or sensitivity. The scales are as accurate as the test weights used to check them.

The complete system has operated through approximately 35,000 cycles. The operators report that currently, in over 99 per cent of the cycles, no irregularity of any sort is experienced. In the remaining less than 1 per cent of the cycles, the difficulty can be corrected within 5 min. In only ten instances out of 35,000 has irregular operation of the equipment resulted in material that could not be recovered.

With constant head of feed in the weigh hoppers, the over-all control accuracy is determined by the constancy of the speed of response of the shutoff valves and the dribble that results after closing the valves. To compensate for these factors, the weight set points are placed as much as 1 per cent of full scale below the actual weight desired and adjusted by trial and error. The operators record the actual weight signaled on the scale which nearly always corresponds to the desired figure.

Daily information is collected on the total amounts of materials handled by the weighing control system. This has been compared to the change in inventory noted from the bulk-storage records. The difference represents losses in handling, volatilization, and discrepancies between several sets of scales, and the error in the system in actually controlling the desired weight additions. These data are presented in Table 1.

It should not be inferred that the actual control weighing errors are necessarily as large as, or even a major portion of, the loss reported. Checks indicate that the weighing-control system is much more accurate than the over-all system. It also has been shown that the greatest single source of weight error is in the bulk-storage system. Here it is frequently necessary to make inventory records "on-the-fly" while material is in transit. An error on the high side one day appears as a shortage on the following day. However, it may be assumed safely that the accuracy of the weighing-control system lies within the over-all reported loss.

The important figure in Table 1 is not the average daily loss of 0.67 per cent, but rather how closely do all the loss figures agree with this average. Consistent loss may be inherent and not chargeable to the scales. The loss figures in the last column of the table agree with the average value within a probable error of ±0.84 per cent, which is thus the over-all measure of constancy and reproducibility from day to day.

Fig. 6 shows graphically a probability curve having the same average and variance as the data in the fifth column of Table 1

TABLE 1 PERFORMANCE RECORD

Date	Number of batches	Weight records — From inventory, per cent	Weight records — Controlled weighing, per cent	Loss, per cent
5/1/53	32	100	98.99	1.01
5/2/53	23	100	99.49	0.51
5/3/53	38	100	99.36	0.64
5/4/53	38	100	99.12	0.88
5/5/53	31	100	99.30	0.70
5/6/53	36	100	99.30	0.70
5/7/53	40	100	99.02	0.98
5/8/53	40	100	99.39	0.61
5/9/53	28	100	100.84	−0.84
5/10/53	31	100	100.69	−0.69
5/11/53	39	100	99.10	0.90
5/12/53	34	100	99.69	0.31
5/13/53	34	100	95.86	4.14
5/14/53	53	100	98.91	1.09
5/15/53	33	100	101.86	−1.86
5/16/53	3	100	99.85	0.15
5/17/53	31	100	98.63	1.37
5/18/53	23	100	98.46	1.54
			Average	0.67

FOR THE FUTURE

Although the equipment described does meet the design expectations completely in so far as speed, accuracy, and positive control of the operations, still, in common with all the usual types of batch-weighing equipment, it leaves something to be desired. The shutoff point represents an unavoidable compromise between speed and accuracy that is achieved only with some effort and liable to shift with changing fluid pressures or characteristics.

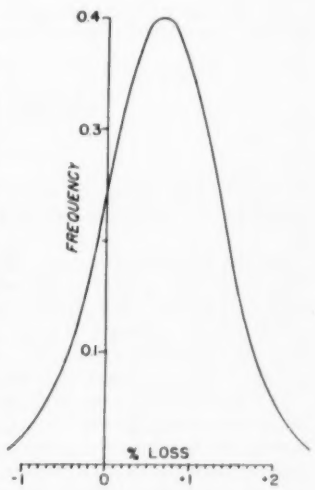

FIG. 6 PROBABILITY CURVE FITTED TO DIFFERENCES BETWEEN DAILY INVENTORY RECORDS MINUS BATCH-WEIGHING TOTALS

Fig. 7 graphically shows the error resulting from both a change in flow rate (BCE) and for an error in the weight-detecting mechanism (FGHB). Both of these errors usually are almost negligible; if they are not they can be made as small as desired by reducing the flow rate at least near the cutoff point. However, this is achieved only at the expense of time.

In order to save time, which may be money, it would be desirable to speed up the control process. To do this there might be a throttling control valve that allows the flow rate to be proportional to the amount that still needs to be added. Looking to the future, someday there may be available a system that has the characteristics given in Fig. 8.

The weight-signal device to detect the tank contents has proportional response rather than on-off control and might be a pneumatic transmitter as shown in Fig. 8. It should provide some output before the weight reaches the desired set-point. Through a suitable controller, this signal can operate a valve to reduce the flow near the end point. With the controller suitably adjusted, a large flow can be brought to a smooth stop.

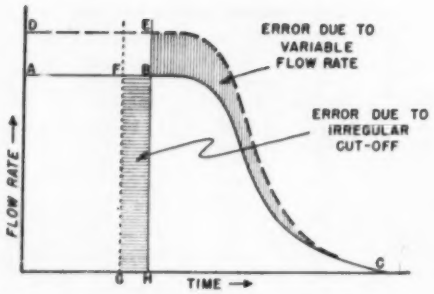

FIG. 7 WEIGHING ERRORS AT CONSTANT FILLING RATE

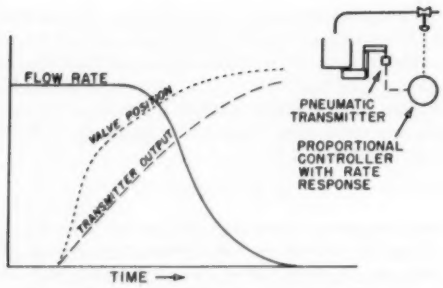

FIG. 8 BATCH-WEIGHING SYSTEM WITH VARIABLE FILLING RATE

The purpose of the rate response is to provide adequate sensing of the actual high-velocity flow to the weigh tank. Thus, in changing from water to molasses, rate response would provide the proper time lead to the control valve, making it unnecessary to readjust the scales for different filling rates. The time lags probably would be determined by the system, not by the fluid, and thus the controls once set would bring any flow rate to a smooth stop at the precise end point.

CONCLUSIONS

Continuous processing can be assisted with batch-weighing equipment and the weight control incorporated into a system including process-control requirements. Considerable flexibility to choose among several different formulas can be provided.

It is suggested that batch weighing could be improved by providing a variable filling rate near the balance point.

Why Prestressed Concrete in the Refinery

(*Continued from page 974*)

tion has the feature that prestressed structural members may be constructed at one locality, shipped to the site, and erected in place.

Another use is in salt-water circuits and other pipe lines. Prestressed-concrete pipe would offer freedom from corrosion and tuberculation. In addition, longitudinal prestressing materially increases laying lengths of large-diameter concrete pipe, reducing construction costs. For example, 2 miles of 84-in-diam prestressed pipe in 18-ft sections are already in place.

As a general rule, prestressed concrete should be considered for services which demand special strength features, fire protection, or freedom from corrosion. These would include cradles, platforms, utility supports, piling, storage bins, and supports for offshore-drilling operations.

SUMMARY

Prestressed concrete definitely has its place in the petroleum industry—be it in oil movement and storage, or in the general structural field. In the particular case of tankage, all available evidence indicates that when contemplating new or replacement facilities, the refiner should consider prestressed concrete seriously. Depending on location, maintenance costs and evaporation losses from steel tanks, plus other factors, the engineer will find that the advantages of prestressed concrete at least match those of steel and in most cases outweigh them considerably.

It now remains for the refiner to seize upon the opportunity presented by the development of prestressed concrete and make full use of all that it offers to the petroleum industry.

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ASME Standards
SAVE LIVES *and* DOLLARS

By FREDERICK S. BLACKALL, JR.

PRESIDENT OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ONE of our Society's greatest contributions to public welfare, to our national defense, and to the nation's industry, is the ASME Program of Codes and Standards. This important bulwark of our economic and industrial life is far too little known and understood and appreciated, except by those who carry it on. In over ninety different fields, the ASME is creating and maintaining, through periodic review, codes and standards for the guidance of industry which have saved this nation, and indeed the world at large, countless millions of dollars and who knows how many lives. It is an outstanding example of co-operative effort. Some 3000 of the country's best engineering talent are contributing their time and effort continuously and voluntarily to more than 350 separate projects incident to it.

The Society's dollar contribution in terms of the difference between income from sales of codes and standards, and the total expense for staff, printing, and distribution, is something over $30,000 per annum, a trivial sum when measured against the returns on the investment to our nation and its citizens. It would be impossible, however, to evaluate in dollars the sum total of counsel, knowledge, and brain power which is contributed to this effort by representatives of industry, members and non-members alike, or by the literally hundreds of trade associations and sister societies which are vitally concerned with the standards developed by ASME. Suffice it to say that the widespread, unconditional, and voluntary nature of this outpouring of effort in a common cause is tangible evidence of the tremendous savings to industry and the benefits to the general public which are the direct result of this program.

It might be appropriate to remind you of a few examples which constitute eloquent testimony of the vital influence on our everyday lives of the ASME Standards Program.

* * * *

The ASME Boiler Code has been made the basis of laws enacted by 20 states and 23 municipalities and thereby has become enforceable by state or local authorities. In addition, every one of the Canadian Provinces has adopted the Code as a whole, or in part. As a result, no boiler for steam power generating purposes is made, or could be sold, in this country or Canada which does not bear the ASME seal indicating that it meets the minimum standards established by the ASME Boiler Code. Hardly less important as a guardian of public safety is the ASME Code for Unfired Pressure Vessels. Both of these standards deal with physical properties, the metals employed, details of construction, and such matters. They are specific enough to insure that any boiler or pressure vessel constructed to these specifications will be safe and serviceable for the purpose intended. At the same time, they are broad enough to allow the individual designer and manufacturer ample latitude for the exercise of his own inventive genius and technical skill.

Presented at the President's Luncheon of the Fall Meeting, Rochester, N. Y., October 5–7, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Primarily as a result of the ASME Boiler Code, boiler explosions and the frightful loss of life and property attending them, which once were commonplace, today are a rarity. ASME'S success in this field has been so significant that the ASME Boiler Code is in use in the United States and Canada, from coast to coast. Its leadership in this important field has resulted in the selection of the ASME Boiler Code Committee as the Secretariat for an international standardization project for boilers.

Perhaps one of the most cogent guardians of the public safety of every one of us is the ASME Elevator Code. At the present time, 17 states have used this code as a basis for laws covering the installation and operation of elevators. There is dramatic evidence of its contribution to public security in the experience of New York City. In the Borough of Manhattan, there are some 21,700 passenger and freight elevators. The record of accidents during 1946, issued by the Municipal Building Department, shows that 97 per cent of all accidents and 100 per cent of all deaths in that year occurred on elevators which were installed prior to 1931, at which time the city adopted for the first time a modern elevator safety law, modeled on the ASME Code. In my own State of Rhode Island, enforcement of the Elevator Code reduced accidents in the first year by 54 per cent. An annual bulletin issued by one of the leading elevator manufacturers regularly includes an estimate of the extent by which serious or fatal accidents could have been reduced in the prior year, if the elevators involved had been equipped with adequate safety devices required for new elevator installations by up-to-date elevator safety laws based on the ASME Code. For 1950, this estimate was 44.2 per cent for passenger elevators and 50.9 per cent for freight elevators. Reliable statistics indicate that the lives of at least one half of the people who died during the past two years because of elevator accidents would have been saved if the elevators involved had been equipped in conformity with the American Standard Elevator Code, formulated by the best brains available in this field, through the co-ordinating direction and sponsorship of The American Society of Mechanical Engineers.

* * * *

Other examples of ASME Codes and Standards which have found their way into law or have provided an almost verbatim basis for laws and ordinances are the Plumbing Code, which has been adopted by 19 states, the Code on Manlifts, already adopted by the State of New Jersey and under consideration by others, and the ASME Uniform Smoke Ordinance.

The contributions to the public safety of ASME Codes do not stop, however, with those which have been enacted into law. Many of them have been adopted voluntarily by industry with immediate and striking reductions in the accident rate. Typical examples are the safety codes for cranes, hoists, and derricks, and compressed-air machinery.

But the protection of life and limb is but one phase of this vast program, which is a jewel of many facets. Consider, for example, what a boon it is to the users of industrial products to

have complete interchangeability and uniformity of fundamental design in such commonplace but indispensable devices as gages, small tools, and machine-tool accessories, and to have the tables, spindle noses, and other essential elements of all machine tools designed in such manner that tools and accessories, regardless of their manufacture, can be moved from one machine to another without fitting or changing. In the field of design, interchangeability, and tolerances, ASME Standards have not only saved industry millions of dollars, but have heralded a new era of technical co-operation among the manufacturers of the Unites States.

As a gage maker, I well remember that when the American Gage Design Standards were first proposed, there was grave doubt among the gage manufacturers, as to what the impact of a common standard would be upon their volume of business. In those days, each manufacturer wilfully attempted to make his product just enough different from the other fellow's so that there was no chance of interchangeability between, say, a handle made by one company and a gage member made by another. Today, of course, complete interchangeability exists between them. Much to the surprise of many, the result was to increase rather than decrease the use of gages with direct and beneficial effects upon the sales volumes enjoyed by the gage makers and, incidentally, with signal improvement in the quality of the product turned out by the users.

* * * *

And then consider the contributions of ASME Standards to the national defense. One of the most striking of these is the relatively recent adoption of a screw thread accord by the great English-speaking nations, the United States, Britain, and Canada—the backbone of the free world. The screw, the bolt, and the nut are relatively homely, commonplace gadgets, but never forget that these are the elements which, to a large extent, hold together our mechanized world and the equipment which it lives on. The British use a slightly different form of thread from ours, called the Whitworth. The top of the British thread is round, whereas ours is flat. The included angle between the flanks of their thread was 55°, whereas ours is 60°. Can you imagine the operating difficulties which this involved when these great nations were fighting as allies against a common enemy? During World War II, a British dreadnaught, scarred in battle, out of commission as a fighting machine, limped into one of our Western navy yards for quick repairs while her sister ships and ours were holding the line in the Southern Pacific. Our navy yard was well supplied with spare parts, taps and dies, and the other material necessary to effectuate repairs on any ship built to our standards, but while the allied navies were locked in a life and death struggle, the job was held up for three weeks while parts and tools, built to the Whitworth thread, had to be ordered and flown from England to our West Coast.

Sparked by ASME on our side and its sister societies in England and Canada, a screw thread accord at long last was reached with our allies in 1948, which has been recognized and adopted by the Armed Services and much of industry in all three countries. Today, the ships, the guns, the ammunition, the armed forces materiel of all three countries, are threaded to a common standard known as the American-British-Canadian, or "ABC Screw Thread." As a result, American screw threads today on all munitions of war and an increasing number of commercial products will interchange with those of the whole British Empire. You remember the old saw, "For want of a nail, the battle was lost." Apply it to a bolt or a screw, and it easily could happen again. Thanks to the ABC screw thread accord, it will not happen here.

One of the problems which constantly confronts those who are engaged in a field of activity like engineering, which is constantly piercing new and unfamiliar horizons, is to establish a common language and terminology which will be understood universally wherever it may be used. In this field, ASME has rendered yeoman service in devising standards for symbols, nomenclature, abbreviations, drafting-room practice, graphics, and charts. For example, ASME has just completed a proposed American Standard for the terms employed in nuclear energy development. An activity somewhat related to this type of codification is the standards work done in the fields of measurement and evaluation, examples of which are found in the Power Test Codes and the Standards for Instruments and Apparatus.

A closely related field is that of the Standards of Recommended Practice—for example, the standards evolved for the cleaning of turbine lubricating systems and the guidance for inspectors set forth in such publications as the Elevator Inspectors' Manual, Material Specifications for Boilers, etc.

The expansion of engineering horizons frequently makes it important or necessary in the establishment of new codes and standards, manuals of recommended practice, and tables of data, to undertake a collateral program of study and research. Here the research program of the ASME has become an invaluable tool for engineering progress. A direct outgrowth of the research program, working hand in glove with ASME Standards and Codes Committees, has been the publication of a number of tremendously useful works in the field of metal-cutting practice, such as the Manuals on Cutter Life, Cutting of Metals, and the ASME Metals Engineering Handbook now in preparation.

Furthermore, there are certain fields of broad and general interest, of a type defined by Dr. Vannevar Bush as "background research" to which a Society-sponsored research program is especially suited. An editorial published in the March, 1953, issue of MECHANICAL ENGINEERING touches on this point and notes as particularly appropriate examples of important background research, conducted by our Society, the development of steam tables, the properties of gases and metals, the effect of temperature on physical properties of structural materials, etc. The work done through our research and standards programs in these fields and on Pipe Flow and the Basic Laws and Data relating to Heat Determination, etc., has been invaluable to the pure scientist, the engineer, the manufacturer, and the industrial consumer alike.

It is, of course, not possible to be categorical about the objectives of any particular standards program. A standard which achieves optimum design through the concerted effort of the best brains in any particular field is pretty sure, for example, to bring about a greater measure of safety for those who use it or are exposed to it. Common design ordinarily brings about a greater interchangeability among the products of all manufacturers. Greater uniformity of tolerances is a usual by-product and inspection procedures are clarified. Of course one of the greatest gifts of standards and codes to the producer and the consuming public lies in the enormous savings which are brought about through simplification, elimination of needless and overlapping sizes and styles of product. The American Standards Association, originally founded in 1918 by five of the great engineering societies, including ASME, as a co-ordinating service organization in the development and promulgation of standards, recently published a series of case histories dealing with the extent and nature of these savings, entitled, "Dollar Savings Through Standardization." The figures quoted are certainly impressive. To cite one or two examples, the Western Electric Company estimates that it is saving at least 20 per cent on the cost of all the millions of screws which it buys for the entire Bell System through the adoption of American Standard thread sizes. They estimated further that standards work in

the field of tools and gages has saved the company more than $15,000,000 in the past 25 years. These figures are worth quoting, since they are authentic and official, and indicate the extent and nature of economies actually effected by one large volume buyer, through standardization. Consider what the aggregate savings must be to users of all of the products covered by ASME Codes and standards, which encompass a far broader field.

* * * *

I should like to discuss with you for a moment something of the philosophy of standardization—the techniques which should be followed, the spirit in which it should be approached by those who join hands in effecting it, the pitfalls to be avoided.

In the development of standards, it is vital that the job be done in such manner that the resulting standard will be a boon to all and not simply devised to meet the requirements, real or fancied, of one specialized group or another, no matter how important or powerful. In approaching this problem, the needs of the small producer and the small consumer should never be overlooked or treated with contempt. Do not forget that there are a lot more little fish than big fish in the economic puddle, and that the aggregate output of the latter dwarfs that of even the greatest of our giant corporations. What is more important, no standard will succeed, except it be of narrow and special scope, unless it is pretty generally applicable.

Sometimes, of course, a particular industry may have specific needs which the general user does not require. Since, more often than not, these are more imaginary than real, every effort should be made to see if, indeed, this is not the case. But if, in the final analysis, compromise on a single standard is not possible, half a loaf is better than none. It is not necessary to be too stiff-necked in such a situation. The problem can be resolved through optional standards for specialized needs.

The standardization of fundamental design, as distinct from features of design adopted for the purpose of achieving interchangeability of fittings and accessories should be approached with the utmost caution. Engineers should recognize that conformity to accepted principles should be the servant and not the master of creativeness and invention. Efforts to provide a common standard should always be carried out in such manner that ample scope is still allowed for individual ingenuity. Otherwise, they become a roadblock to progress, and engineers degenerate into a mere police force, devoted to the maintenance of the status quo. In the ideal case, the engineer must be half practical, half dreamer; and the importance of the second component must not be underestimated. Nothing should be done to circumscribe it.

In setting up a Standards Committee, under ASA procedure, it is required that representatives of users, manufacturers, and the general public be included in its membership. These groups, as well as competitors among the producers, will find that they must give and take if their efforts are to be crowned with success. Here, if anywhere, is an area in which the Golden Rule should be the guiding spirit. Do not be discouraged, however, if, in the early phases of a new standards program, self-interest and a lack of consideration for the other fellow's point of view come to the fore. It is natural that they should, but it is my experience that as time goes on, differences of opinion are reconciled through a growing recognition that what is good for the great majority is generally best in the long run for the individual. As our legal friends put it, a successful standards program must always be affected by the public interest.

Finally, the makers of standards and codes should not overlook the dollar sign. To be sure, the optimum design may not always be the least expensive, but cost is a factor which must be considered. Sometimes, particularly where the specialized needs of a particular group of industry tend to predominate, this may be disregarded. I often wonder if the presence of a comptroller or two, or perhaps a vice-president in charge of purchasing, with a good technical background, might not be a worthy addition to the personnel of the committees charged with the development and promulgation of technical standards. Never forget that standards, to be effective, must be economic. Otherwise, in the long run, they will simply be ignored.

* * * *

In selecting the personnel of a standards Committee, a conscious effort should always be made to secure as members those who are best informed on the subject under consideration, and who are best qualified, both by temperament and intellectual store, to carry the work through to a successful conclusion. This sometimes involves going outside of the roster of membership to find the one best man for a particular assignment. Indeed, non-membership should never be a barrier to selection, but it is perhaps unnecessary for me to suggest that once a man has put his shoulder to the wheel in a task of this sort, an effort should be made to interest him in becoming a member. This, in fact, has frequently brought new members into the Society, and I believe there is nothing improper in the suggestion that members of Standards and Codes Committees should not miss an opportunity to do a little proselyting in behalf of our Society under such circumstances!

The selection of the chairman of a Standards or Code Committee is important. He should be a man who has a good sense of organization and the ability to keep his eye on the ball. He should be able to strike a proper balance between providing full opportunity for the expression of every point of view, and avoiding needless delays and procrastination in the process. In brief, he should possess those qualities of leadership which will inspire his committee to drive the task through to a successful conclusion with all reasonable dispatch.

The employment of subcommittees for special assignments and the more abstruse and technical work involved is a useful dodge in standards activities. In this sort of work, small committees are frequently more effective than large ones. In such cases, the subcommittee naturally carries the heavier share of the load, but the main committee performs an important function in acting as a board of review and final court of appeal in resolving differing points of view.

* * * *

Finally, I should like to issue a special message to the three thousand or more members of our Society who are engaged in this great activity. This group, which includes some of the most competent engineers in our country, is performing an important public service, and we are grateful to them. As one who has come up in the Society via the Standards and Codes route, I have observed that the Standards Committee work is virtually the only point of contact with the Society for a good many of the men who are engaged in it. This is probably natural, for the work is unusually demanding of time and effort. Sometimes, also, the Codes and Standards Committee member is so much of a specialist in his field that his interest is not readily attracted to other phases of engineering. Nevertheless, those of us who have participated more broadly in ASME activities have learned that, within the Sections, within the Professional Divisions, and in the administrative work of the Society, there are also satisfying opportunities, which are stimulating and rewarding too. We urge every Standards Committee member, who is not already doing so, to explore and take part in the other activities of the Society as well.

ASME has good reason to be proud of its great program of Codes and Standards. In few endeavors is there greater opportunity for the exercise of enlightened self-interest, coupled with the performance of an outstanding public service.

HIGH-SPEED WEIGHING

By NORVIN G. MALONEY

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THE speed of present-day packaging machinery and the laws governing interstate commerce place the weighing of packaged materials in the dual position of an economic disaster and a legal necessity. When the net weight is stated on the package, a large give-away has been the custom to avoid severe penalties for underweight. The cost of this give-away is often equal to a major portion of the net profit. In some packaging operations, such as explosives, extremely close control of the package weight is required to meet a specified performance.

The variation of weight from any packaging operation is usually a well-defined frequency distribution curve.[1] If we could select and reject a few per cent of the heaviest and lightest packages, we would hold close tolerances on the major portion of the packaged material. Only by weighing each package can this be achieved.

PROBLEMS OF HIGH-SPEED WEIGHING

When the project on high-speed weighing was started at the Mechanical Development Laboratory, we were given a goal of 300 packages per min. However, the results of a fairly intensive search for automatic weighing equipment at that time indicated that the highest-speed equipment on the market was about 60 packages per min per weighing station. By placing a weighing station on either side of a single conveyer, it was possible to weigh 120 packages per min by indexing alternate packages to opposite sides of the conveyer.

Tests were made indexing packages at 300 per min and a package that was supposed to move 6 in. would not stop in less than 2 ft. This was based on one half the cycle time for indexing and one half for weighing. It was apparent that indexing a conveyer was not compatible with high-speed weighing—not if an equilibrium state was to be associated with the motion. It also was apparent during these tests that packages containing loose material which could shift around within the package would prove troublesome. Such packages would have to be handled with a minimum of acceleration, or the total mass would not be at the constant one g (one gravitational unit of the earth) acceleration needed for a weight determination. Therefore all plans were abandoned to index the conveyer and the fact was accepted that the conveyer would move at constant speed. Also, the individual article to be weighed would be on a pallet or sled that was attached to the conveyer by a drag link long enough to allow sufficient vertical motion for weighing, without causing a significant force in the vertical direction. The same result can be achieved by a stiff container that can be pushed and allowed to slide on its own bottom. Actually, our first tests were on paint cans that were pushed along by ball bearings; later we built a more complicated articulated conveyer that is independent of package shape and rigidity.

All that remained was to weigh the package and pallet while it was in motion. The total cycle time available was $^1/_5$ sec. Allowing one half the cycle time, we had $^1/_{10}$ sec for the total weighing operation and, therefore, were primarily interested in the time rate of response of the weighing system.

MEASURING BY ACCELERATION

At this point it becomes obvious that we would be unable to use the conventional scales operating like an apothecary's balance. The time required to reach equilibrium is too long. Thinking of the operation resulted in adopting the principle of measuring the acceleration. This acceleration could be measured in a very short interval of time and would enable us to measure 300 units per min. As far as we knew, this principle had not been used for weighing.

The basic principle of this weighing is Newton's second law, $F = Ma$, where F = force, M = mass, and a = acceleration.

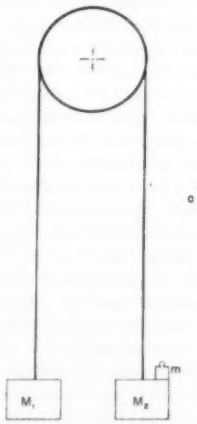

FIG. 1 MASS SYSTEM FOR DYNAMIC WEIGHING

$$a = \frac{m}{M_1 + M_2 + m}\, g$$

It is realized by everyone who has studied physics that this is the basic vector equation of the dynamic response of mass systems. Why not use it in a dynamic sense for high-speed weighing? Why not determine the acceleration of a mass system to find the relation between a known mass and an unknown mass? Fig. 1 is a schematic diagram of a mass system where the known mass M_1 can be compared to the unknown mass $M_2 + m$. We purposely abandon the balance point and use sufficient unbalance to provide the speed of response we need.

This, then, is not a resonant system but a divergent one. No matter how far the masses are allowed to move they never come to rest at an equilibrium position. The acceleration can be obtained from the equation, $s = {}^1/_2\, a\, t^2$, where s = distance, a = acceleration, and t = time.

If we analyze this simple system for small amounts of unbalance, m, we obtain a set of curves as shown in Fig. 2. The curves purposely were plotted to trace the path of the mass that is being compared to the standard mass. The downward motion depends on the amount of unbalance present. In the horizontal plane the mass moves at constant velocity with time. It is apparent that we can use short time limits if we can use small deflections.

We have considerable choice. There are three variables in our system:

[1] "Statistical Aspects of Specifications," by H. H. Johnson, MECHANICAL ENGINEERING, vol. 75, 1953, p. 447.

Contributed by the Instruments and Regulators Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and presented at the Eighth National Instrument Conference, Chicago, Ill., September 21–25, 1953.

(1) The unbalance ratio, $m/(M_1 + M_2 + m)$.
(2) The time interval of motion.
(3) The distance or vertical displacement.

The design of a mechanical system to use this principle for weighing requires that we define our objective. We may wish to:

1 Reject underweight packages.
2 Reject underweight and overweight packages.
3 Determine the weight of a package.

While all of these objectives are possible, for the purpose of simplicity we will consider only the first one, a "go—no go" design at this time.

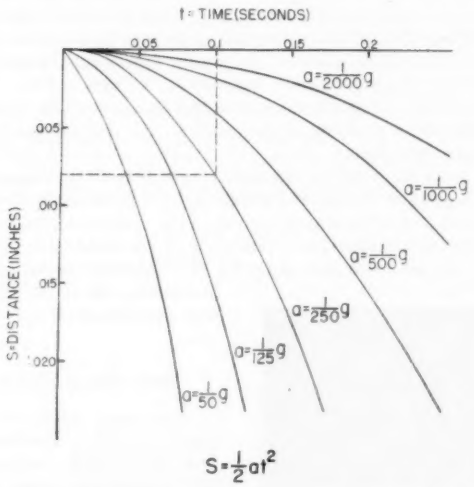

FIG. 2 DISTANCE VERSUS TIME FOLLOWING RELEASE OF MASS-BALANCED SYSTEM FOR SMALL VALUES OF UNBALANCE

THE EXPERIMENTAL UNIT

Now let us proceed from principles to a discussion of the details and problems involved in the experimental unit.

The first problem an engineer recognizes in any production device operating at 300 per min is wear or endurance limit. If it is subject to wear, it will wear out fast.

Another and very severe problem is that the coefficient of friction with a moving conveyer requires that we live with a large drag force on the scales or accept the chatter from rolling equipment. Since we would have to use a small deflection and probably would have to operate in dusty atmospheres, we chose sliding for our first test design.

Fig. 3 shows the weighing scales. The suspension is by flexure pivots designed to be loaded only a few per cent of the endurance limit. Wear is not a problem and friction resulting from vertical motion is negligible. The required freedom of vertical motion and stiffness in all horizontal directions is achieved by using a three-point suspension at one end of a parallelogram and four suspension points at the other end. The large drag force has little effect on this suspension when the linkage is parallel to the direction of motion.

The float immersed in liquid (mercury) is not only immune to wear but is a direct way to obtain an opposed reference mass in the simplest possible manner without a pulley or other mechanical device. The forces are directly opposed.

As the weigh table and float with the package exceed the buoyant force of the liquid displaced by the float, the entire mass of the system is accelerated by the difference in mass between the liquid displaced and the package with its tare weight of equipment. We purposely kept the increase in buoyant force to a minimum by suspending the float on a small-diameter rod that enters the surface of the liquid. The float was immersed completely and the buoyant force was essentially constant.

A means of locking the weighing table in the up position and releasing it at the proper time with respect to the position of each pallet of the conveyer required considerable care in design. It is important that the article to be weighed and the pallet on which it rides plus the mass of the weighing table and float all be at rest in the vertical plane. The package and conveyer can have the constant velocity they need in the horizontal plane, but the vertical motion is the criterion of the state of balance between the unknown package with its tare weight of equipment versus the weight of liquid displaced by the float—the reference mass. Any vibration of the locked-up system would result in an initial velocity at the moment of release. The velocity might be in the up or down direction and would influence seriously the distance traveled by the mass-balanced system in the controlled interval of time. A rigid system with a high natural frequency that is not likely to be excited by associated machine speeds is needed to provide the constant datum for weight determination by this means.

Similarly, the detail of the locking device must be controlled so that the release of energy when the weigh table is unlocked

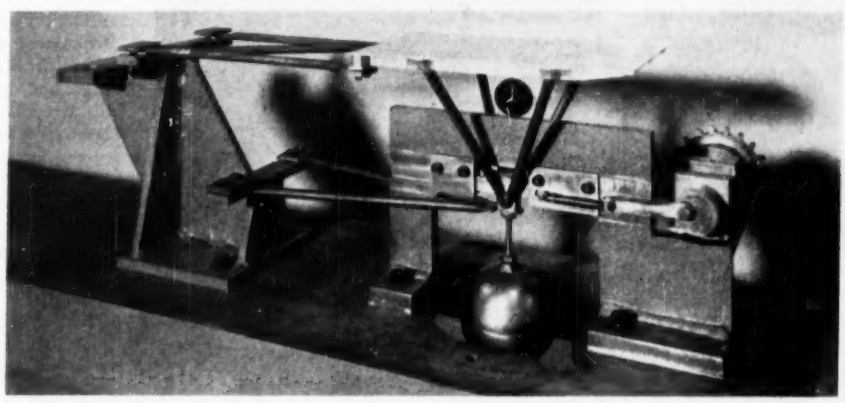

FIG. 3 HIGH-SPEED WEIGHING SCALE

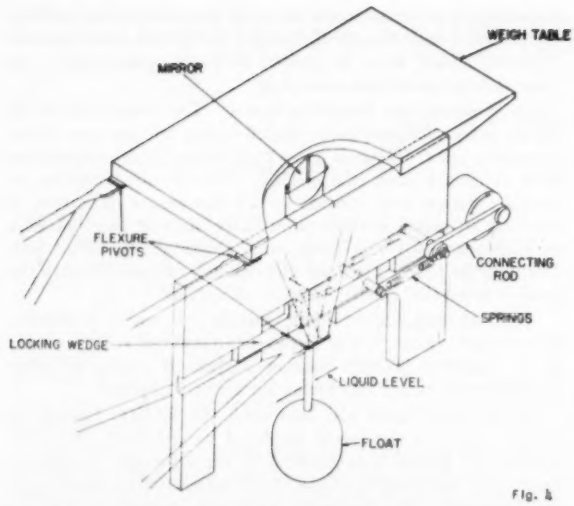

FIG. 4 SCHEMATIC OF WEIGHING SCALE SHOWING DETAIL OF LOCKING WEDGE AND DRIVING MECHANISM

is a minimum. Large spring forces that would accelerate the weigh table downward are detrimental, particularly if the spring pressure is not constant. Since engineering materials obey Hooke's law, the release of a clamping pressure is always attended by a release of energy. With this viewpoint clearly in mind, we designed our lockup for the weigh table with a controlled actuating force through a spring and attempted to limit the clamping force, not only in magnitude but also to contain it in a most rigid system of minimum dimensions.

Fig. 4 shows the simple crank and connecting rod with the spring to limit the pull on the locking wedge. For unlocking the weigh table, a solid positive connection is obtained at the maximum velocity of the connecting rod to drive the wedge out and release the scales at a precisely controlled time with respect to the conveyer position. The wedge follows the motion of the connecting rod for only one half of its travel or less. The spring is stretched for the remaining distance. The top and bottom center positions of the crank are the approximate lock-up and unlock points.

In order to avoid interference from pallets or packages that are entering or leaving the weigh table, it is necessary to limit the unlocked or weighing portion of the cycle to less than one half the total cycle time. The ratio of unlocked to locked-up time can be controlled easily by changing the length of the connecting rod or an equivalent adjustment of the linkage.

FIG. 5 FIRST HIGH-SPEED WEIGHING SETUP

WHAT TESTS REVEALED

Tests were conducted on this basic type of mechanism, first with rigid containers, Fig. 5, in which 1-pint paint cans were used, and later with an articulated conveyer, Fig. 6.

The primary purpose of the articulated conveyer was to allow the weighing of sacks, bags, and other types of soft or irregular containers or masses. Our early suspicions of the instability of the mass in this type of package were well justified in our tests. A cloth sack about half full of steel washers is a good example of a mass that will slip

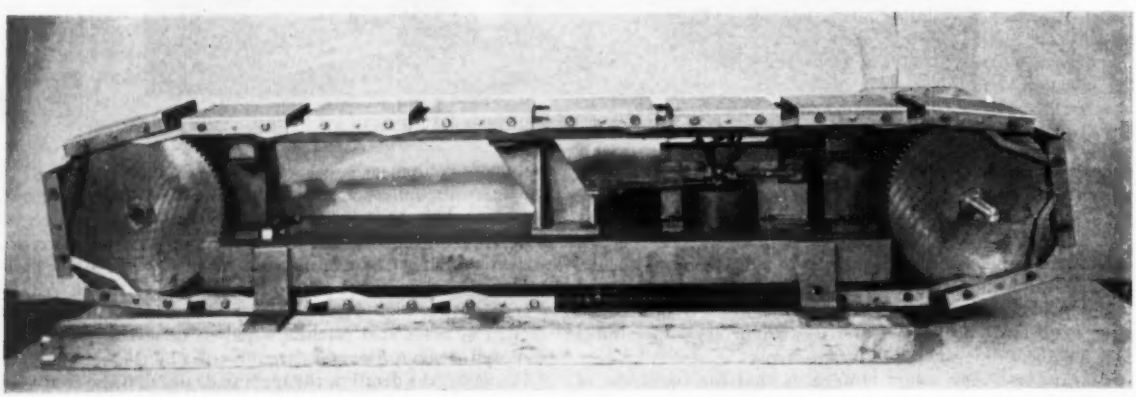

FIG. 6 HIGH-SPEED WEIGHING WITH ARTICULATED CONVEYER

and slide internally when disturbed by even slight accelerations. However, by careful design, it is possible to move these masses in a constant state of motion and weigh them quite accurately.

The vertical fall of the weighing table was indicated by a concave or focusing mirror mounted on a horizontal axis of rotation with about a $^1/_4$-in. radius and connected to the table. A photocell placed about 15 ft away intercepted the light beam after it had moved about 1 ft from the locked-up position. The magnification of motion was about 1500 to 1. The weighing table was required to drop only 0.008 in. to give this response.

In all of our tests we were able to weigh packages at a rate of 300 per min with an error of less than 1 per cent. Data from a typical test using rigid containers are given in Table 1.

TABLE 1 TEST USING RIGID CONTAINERS

Tare weight of weigh table with float, gm	1092
Additional mass needed to balance scale (package), gm	1523
Maximum package that would not trip photocell, gm	1528
Minimum package that would always trip photocell, gm	1542

Within a range of 5 to 19 gm over the equilibrium mass, the system would respond in an indiscriminate manner. Since the total mass of the system was over 5200 gm and the maximum unbalance force needed to accelerate the system was 19 gm

$$a = \frac{m}{M_1 + M_2 + m}\, g$$

$$= \frac{19}{(1092 + 1523) + (1092 + 1542)}\, g$$

$$a = \frac{1}{276}\, g$$

With a variation from 5 to 19 gm and an equilibrium mass (package) of 1523 gm the scatter or

$$\text{Per cent error} = \frac{19-5}{1523}$$

$$= 0.009 \text{ or } 0.9 \text{ per cent}$$

These special test packages were sent across the weighing table many hundreds of times, always at a rate of 300 per min. The scales and photocell never failed to sort them properly. We carefully had adjusted the weight of the packages to fairly safe go—no go limits. If we wished to reject both underweight and overweight packages, we would need two separate scales of the type we have just described. One would indicate underweight, the other overweight.

HOW FAST CAN SYSTEM WEIGH?

The question arises: "How fast can one weigh with this system?" Unfortunately, we cannot give a specific answer at this time, but we can point out that at 300 units per min we were about 1 per cent of the package weight off balance. It is not until the opposing force disappears from the system and it becomes a free-falling body that it ceases to be a weighing system. A patent application, covering our particular high-speed weighing system, has been filed.

Having given a description of this high-speed weighing system and the elementary mechanical device incorporating it, we would like further to explain the basic system we are using. Many people who are quite familiar with this principle of dynamic measurement do not recognize it in a weighing scale.

Did the reader ever have to measure the peak value of the inrush current of an electric motor? If he has an oscillograph with galvanometers, he can have a wonderful time with resonant frequencies and the percentage of critical damping. But he doesn't need such fancy equipment. An ordinary old-fashioned slow-movement ammeter will do the job and do it accurately. All that is needed in addition to the normal ammeter is a stop that will hold the pointer or movement upscale at any position that one cares to set it. In use, simply set the reading on the ammeter and start the motor. If the needle does not jump off the stop, the guess is too high. If it flicks up-scale by ever so little, the guess is too low.

OTHER METHODS POSSIBLE

This example illustrates the use of opposed force-type instruments to read peak dynamic values. We are doing the same thing with our high-speed weighing. They are both preloaded devices. We have gone one step further and are evaluating the jump of the needle for automatic use with a photocell within an accurately controlled interval of time.

In place of the mirror and photocell, we could use some very highly developed devices that measure rate or change of rate of motion, often referred to as the measurement of derivatives and higher derivatives.

An example much used in electrical control systems is a coil in a constant magnetic field. Motion of the coil produces a voltage proportional to velocity, the first derivative of motion. If this signal is fed to a differentiating circuit, the output voltage will be proportional to acceleration, the second derivative of motion. The speed of response is limited only by the time constants of the circuits employed.

Such devices that evaluate rate of movement could be used with the basic preloaded system and they would do more than just check weighing. They could tell us how much overweight or underweight a package is with respect to our standard mass, and they could do it in a very short time with very little deflection.

There is one more thought to consider in attempting to show the fundamental difference in speed of response between the resonant system and the divergent system. Fig. 7 shows the response of a typical resonant system. Whether or not the system is preloaded the resonant frequency does not change. Only the amplitude of response is affected. Now, if the system is critically damped, it will be within 0.1 per cent of its rest position in one cycle of its resonant frequency. The deflection has no effect on the response time. Only by increasing the resonant frequency can the response time be shortened. There is a specific relation between resonant frequency and the one g deflection of an elastic system.[2] The higher the resonant frequency, the smaller will be the deflection. To obtain an equivalent response time of $^1/_{10}$ sec would require a resonant frequency of more than 600 cycles per min, and therefore a maximum deflection of not more than 0.1 in. with no preload. The major problem would be to damp accurately the motion of a large mass with such a small deflection.

In contrast, attention is directed to the small square at the origin of the response curve of the resonant system. It doesn't make much difference if the system is resonant or divergent if the square is small enough. That is another way of saying that if the spring force of the system does not increase significantly, we can ignore it. This is particularly true of low-frequency large-amplitude systems. If we assume the increase in force to be negligible for a small deflection, we can go back to Fig. 2 and say that

$$s = {}^1/_2\, at^2$$

[2] "Mechanical Vibrations," by J. P. Den Hartog, third edition, McGraw Hill Book Company, New York, N. Y., 1947, p. 45, fig. 29, a graphic illustration of equation [17a].

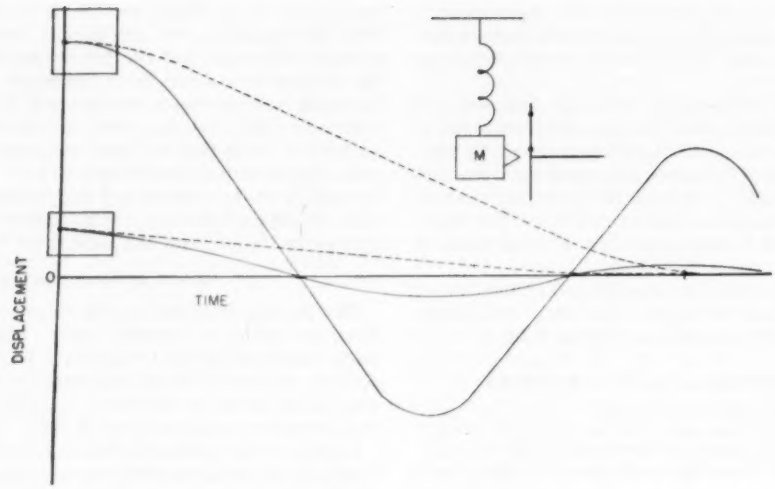

FIG. 7 TYPICAL RESPONSE OF A RESONANT SYSTEM WHEN RELEASED FROM A FIXED POSITION

is essentially true, that the various curves in Fig. 2 are a reasonably close approximation of the resonant system for various degrees of preload as, for example, when the release point approaches the rest position. But these curves of response are those of a divergent system and, even when designed as systems of low resonant frequency, can be used for measurement of force in very short intervals of time provided the deflection is kept small.

CONCLUSIONS

From the foregoing comparison of resonant versus divergent systems, several conclusions can be made:

1 Resonant systems for high-speed measurement require small deflections and accurate damping.

2 Divergent systems for high-speed measurement need small deflections and accurate interval of time.

3 Both systems require small deflections and we chose to try to control the interval of time rather than the damping.

In general, a measurement is considered to be concerned with a transient from one steady-state condition to another steady-state condition. For many types of measurements this is necessary. But when the time derivatives of distance, velocity, acceleration, or jerk are to be measured in a controlled or known system, the initial value of the transient is all that is needed to evaluate the system. For high-speed weighing we wait only for the beginning of motion to determine the comparison of an unknown mass and a known mass.

New Developments in Liquid Heating of Plastics-Processing Machinery

(Continued from page 962)

using an accumulator would need to be only one third the size of that needed for the direct-steam-heated press. Or, to put it another way, it would be possible to triple the number of presses served by a given boiler installation by converting from steam to high-temperature liquid and using an accumulator.

CONCLUSION

Most plastics engineers at present content themselves with control methods which use either the liquid temperature or metal-wall temperature as the basis for control, and rely upon trial and error to determine the temperature which will produce the desired result. The surface temperature control which is now available for calenders using liquid heat carriers indicates the possibility of developing more basic and effective temperature-control methods for other plastics-processing equipment.

Even with present controls, however, we can generally be entirely satisfied with the results produced by properly designed liquid heating and cooling systems. Because of the substantial advantages offered by liquid heat-transfer agents, they are rapidly displacing other media in plastics-processing applications.

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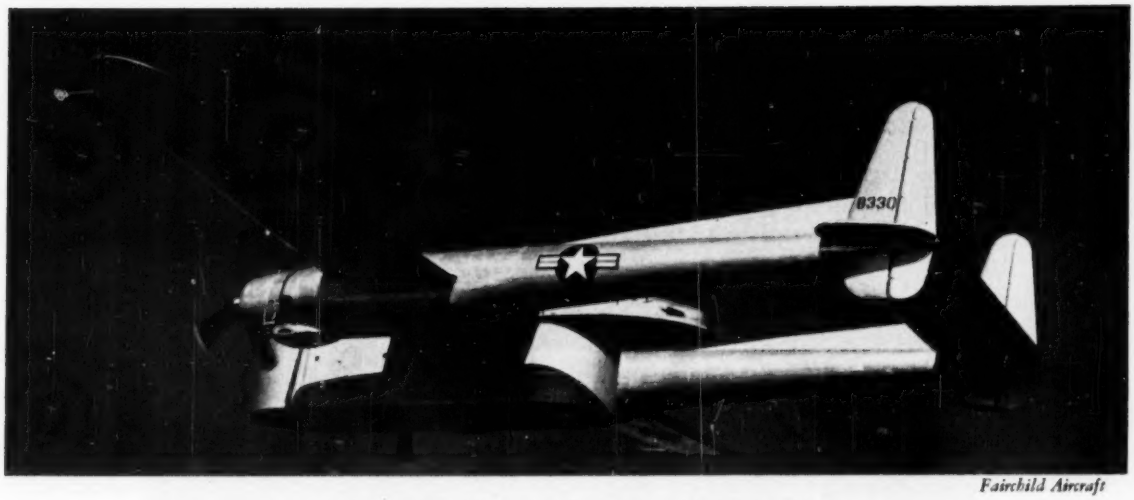


Fairchild Aircraft

THE FAIRCHILD XC-120 IN FLIGHT WITH ITS ROADABLE PACK

ASME ROLE IN POWERED FLIGHT

By HARRIS F. REEVE

FLIGHT SAFETY FOUNDATION, NEW YORK, N. Y.

FROM ITS earliest inception The American Society of Mechanical Engineers has forecast the progress of, and provided a forum for, aviation and its technical challenges.

The very first President of the ASME, Robert H. Thurston, Professor of Mechanical Engineering at Stevens Institute of Technology, in his Presidential address in 1881, established the interest of the ASME in the future of flying. He recognized the need for light-weight power plants and forecast the victory of heavier-than-air craft over the balloon. Professor Thurston went on to say ". . . and it is today true that we are getting on, that even in the science of aeronautics, progress, although slow, is still to be observed year by year and there is no department of engineering in which the art of the mechanic has opportunity for greater achievement."

In this very first ASME address, he sketched the development of the balloon from the hot-air filled invention of the Montgolfier Brothers in 1783, the use of hydrogen by Charles two months later, to the first application of power to the balloon by the French Naval Engineer, Dupuy de Lôme, who ". . . succeeded in giving to the balloon a slow motion by means of a screw, and directing its course by a rudder." The screw was powered by the muscular efforts of four to eight men, and while the balloon could be moved slowly in calm weather, it "gave no encouragement to hope that self-impelling balloons will ever be successful." Thurston concluded, again prophetically, that "our only hope lies in the direction of flying machines, lifted by their own power, not buoyed up by gas."

After tracing the early studies of the flight of birds and insects, Professor Thurston alluded to the work of Henson, Stringfellow, May, and others who "have made self-impelling model flying machines, some of which have actually lifted themselves in the air, and several which have flown with great speed when once lifted clear of the ground. But the most remarkable achievement of all, perhaps, is that of Henson in making a steam engine . . . producing a third of a horsepower and weighing less than fifteen pounds. Thus we are apparently approaching, though still perhaps far from this goal, and we may barely venture to hope that the engineer who is to combine the elements of success, all of which are becoming determined, will in our day win the fame that awaits the first successful builder of a flying machine."

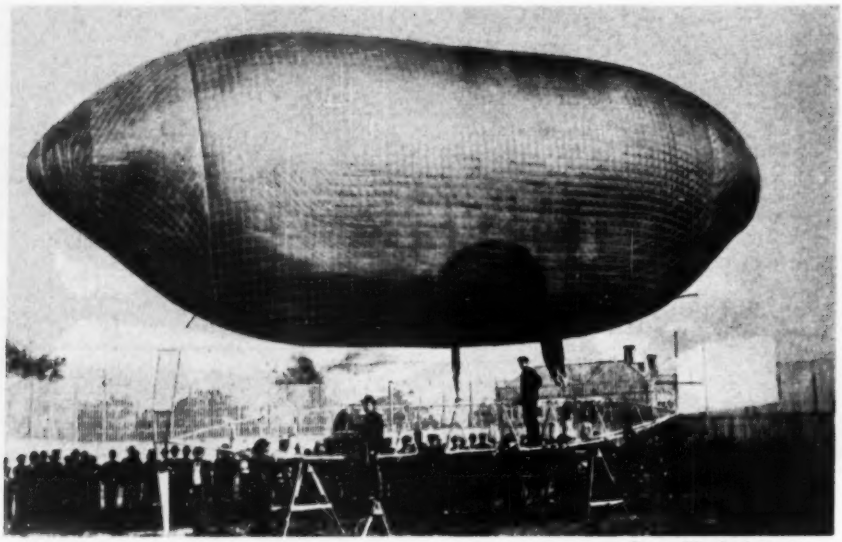
DURAND AND HIS WORK

The next important aeronautical event in the history of the ASME came eleven years later, when William Frederick Durand read a paper at the Annual Meeting of 1892 on "The Limit of Propeller Efficiency as Dependent on the Surface Form of the Propeller." He spoke in 1892 primarily about propellers for surface ships, but the principles involved were equally applicable to airplane propellers.

In 1914 he was asked to assist in the formation of the National Advisory Committee for Aeronautics and served as its chairman during World War I. Among other great services, he helped in the development of the Liberty engine. He had known a young engineer at Cornell University, named Sanford A. Moss, who was then working on gas turbines for the General Electric Company. Dr. Durand made arrangements to secure the services of Moss, and from that work came the turbosupercharger that made possible high-altitude and high-speed flight.

At the age of 82, he was called back to Government service

Contributed by the Aviation Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS in observance of the Fiftieth Anniversary of Powered Flight.



Curtiss-Wright Corporation

CAPTAIN BALDWIN'S "CALIFORNIA ARROW"

(The first aircraft to take off, fly a predetermined course, and return to the starting point. This picture was taken October 25, 1904. Note the man-powered propeller on the left.)

in World War II. He undertook the chairmanship of the NACA committee which brought the Whittle jet engine from England and developed from it the engine for the first American jet-propelled airplane.

Dr. Durand, throughout his long life, has been one of the greatest contributors to the advancement of the aeronautical sciences and industries. His achievements range from the propeller paper of 1892 to the superchargers and jets of today.

WRIGHT BROTHERS' SUCCESSES

The ferment created by the successes of the Wright Brothers in 1903 resulted in an ASME paper, five years after their first flight, by Major George O. Squier of the Signal Corps, U. S. Army. The paper, delivered at the Annual Meeting of the ASME in December, 1908, was on "The Present Status of Military Aeronautics."

SQUIER'S PAPER

Major Squier, later to have charge of the Army Air Service with the rank of Major General, presented "for the first time before a national body of American engineers" an account of the work of the Government in the development of aircraft for military purposes. This covered a review of the progress made with lighter-than-air craft, including dirigible balloons and power plants developed in France, Germany, Great Britain, and the United States.

Turning to heavier-than-air craft, he described briefly the current designs of the Wright Brothers, who in that year had made successful demonstrations at Fort Myer and at Le Mans, France, as well as those of Herring, Farman, Bleriot, Alexander Graham Bell, and Glenn H. Curtiss. He outlined mathematical calculations for determining the lift, drag, stability, and control of airplanes, and reviewed the then current thoughts regarding the uses of aircraft in warfare. With no practical experience in military aviation at the time, only theory was available as a guide, but it was indicated that the chief uses of dirigible balloons and airplanes would be for observation and reporting on the enemy's activities.

Little consideration had been given at the time to the use of aircraft for offensive purposes in warfare. In fact, it was proposed at the Second International Peace Conference at the Hague in 1907 to prohibit the discharge of projectiles or explosives from balloons or other aircraft, but the United States appeared to be the only first-class power who signed the agreement. It was believed that the airplane was not likely to become a burden-bearing vehicle of any consequence.

Comparison With Present Knowledge. Many of the fundamental principles presented by Major Squier were correct, and his contributions were of lasting value. He predicted that an efficient Army, Navy, and Air Force would "serve, not to provoke war, but to preserve peace." This is reflected in the function of the Strategic Air Command of today.

CONTROL AND STABILITY

Several years before 1903, Wilbur Wright emphasized the importance of solving the problems of control and stability. He declared, "Inability to balance and steer still confronts students of the flying problem. . . . When this one feature has been worked out, the age of flying machines will have arrived, for all other difficulties are of minor importance."

A pioneer in the field of theoretical aerodynamics, Prof. Albert A. Merrill presented two papers to the ASME in 1912 and 1913, which dealt with control systems and stability. Of course, to this day the problems of balance and steering continue to produce numerous papers.

Professor Merrill in his paper, "The Efficiency of Control Systems in Flying Machines," given at an ASME meeting in Boston on February 16, 1912, stated: "The first question to be considered is the movement of the levers connected with the control surfaces. The movement of these levers should be instinctive, that is, they should be such as we would make without being taught. To lower the front of the machine the lever should be moved forward; to raise the front it should be moved backward. This is done in all machines and there is never any danger of making a false movement with the fore and aft con-

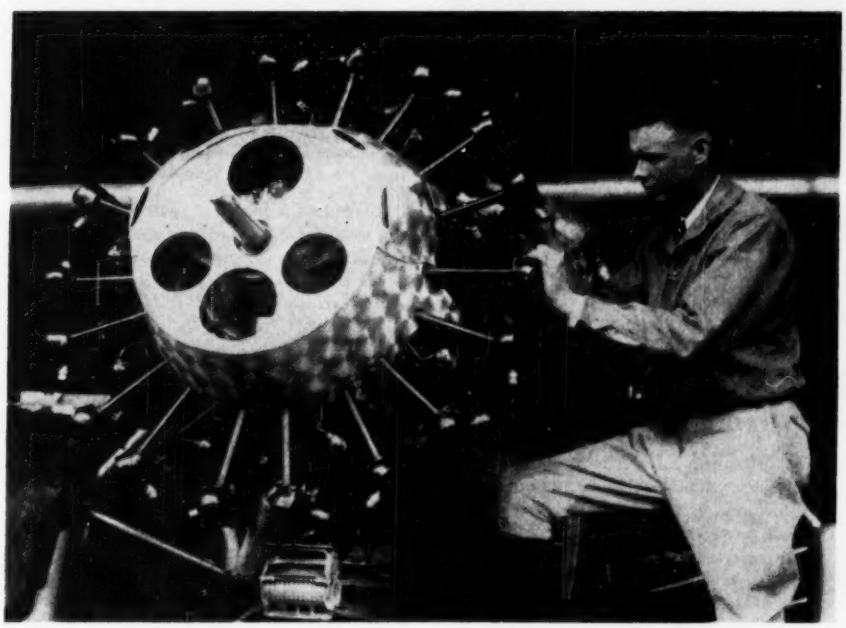
Curtiss-Wright Corporation

THE FAMED JN4F "JENNY," WORLD WAR I FIGHTER PLANE FLOWN BY CAPT. EDDIE RICKENBACKER

trol. When the machine tips laterally, the lever should be moved toward the high side as, when tipping over, it is instinctive to move toward the high side.

"In many machines this method is used, but in some, notably in the Wright machine, lateral control is obtained by a fore-and-aft movement of the lever. It cannot be considered the best system, however, since it is not an instinctive motion and when placed in a dangerous position a man might not make the correct movement. The Wrights use this system because it requires considerable pressure to warp the wings of their machine and more pressure can be delivered by the arm with a fore-and-aft motion than with a lateral motion. However, the work of the Farman and Curtiss machines shows that ailerons will maintain lateral stability as well as warping wings, and as it takes but little pressure to move ailerons, a lateral motion will give the pressure needed."

Thus from 1903 to World War I, the ASME adopted a policy of watchful waiting for opportunities to present technical



Curtiss-Wright Corporation

CHARLES A. LINDBERGH CHECKS 220-HORSEPOWER WRIGHT WHIRLWIND RADIAL ENGINE THAT POWERED THE "SPIRIT OF ST. LOUIS" ON HIS EPOCH FLIGHT FROM NEW YORK TO PARIS IN MAY, 1927
(This was one of the engines of the period that marked a milestone from the standpoint of reliable flight.)

Curtiss-Wright Corporation

IN THE EARLY DAYS OF FLIGHT, THE PROPELLER, LIKE THE PLANE ITSELF, WAS LABORIOUSLY CARVED BY HAND OUT OF WOOD (*above*). CONTRAST THIS WITH MODERN PROPELLER-ASSEMBLY SHOP (*below*) WHERE BLADES OF HOLLOW STEEL ARE ASSEMBLED TO RIGID SPECIFICATIONS. IN FOREGROUND IS A CURTISS ELECTRIC FULL-FEATHERING PROPELLER SUCH AS USED ON THE B-50. ON THE LEFT ARE PROPELLERS BEING ASSEMBLED FOR THE B-36

studies on the progress of successful flight, which had been predicted by Dr. Thurston in 1881.

POSTWAR REVIVAL OF AVIATION INTEREST

World War I disproved the theory discussed in 1908 by Major Squier that aircraft in warfare would be used mainly for observation. Zeppelins bombed London, and explosives were dropped from airplanes. The war proved that burdens could be carried by aircraft. The war accelerated improvements in design, it furnished a backlog of skilled technicians and pilots, it excited interest in commercial aviation. The art of aircraft design was beginning to stimulate greater numbers of engineering papers.

Thus we find two papers in 1917, one by Dr. Durand on aircraft problems, and another by C. E. Lucke on airplane-engine design. Properties of fabrics in relation to aviation applications were discussed at the ASME meetings in 1918, and in 1919 the first paper was presented on subjects which are in the forefront of problems to this day, namely, fueling systems, inspection procedures, testing of parts, and theory of wing design. The year 1918 had witnessed the origin of the scheduled mail service in the United States. The industry was beginning to extend its thinking into operating problems which affected the efficiency and economy of air transportation. This was reflected in 1920 and later, by ASME papers on maximum cruising radius. Sanford A. Moss presented the first paper on superchargers for aircraft in 1920; Frank W. Caldwell and E. N. Fales provided a classic paper on propeller design and a very interesting one for today's operators of airlines was presented by L. B. Lent on "Commercial Operation of Airplanes." This paper reviewed the operations of the U. S. Air Mail Service from October, 1920, to September 30, 1921.

COMMERCIAL USES OF AIRCRAFT

The U. S. Air Mail Service had been operated by the Post Office Department since May 15, 1918, and grew from an experimental run between New York and Washington to a transcontinental service in 1920. The total investment of the Air Mail Service in 1921 was about $800,000, of which $667,000 was for airplanes and engines, and the balance for buildings, trucks, tools, etc. The total personnel employed numbered 482, including 44 pilots. Ten pilots were killed in those 12 months! The equipment had been standardized, comprising rebuilt De Havilland airplanes, with Liberty engines, supplied by the Army and Navy from war surplus stocks. Of the 98 airplanes, 27 were damaged beyond repair! Total flying time varied with weather conditions but average speed for the year was 86.3 mph.

Forced landings and accidents were frequent, according to Mr. Lent, but despite the crude conditions a "creditable" average record of 17,560 "miles per crash" was established for twelve months ending September, 1921, and for the last six months of that period the average was 31,211 miles per crash. (Note: It is now 12,421,000 plane miles per accident and 89,431,000 miles per fatal accident, in domestic scheduled operations.)

About 145 of the forced landings resulted in "crashes" necessitating repairs, of which about 100 were of major scope, averaging about $1000 in cost and requiring about two months per airplane. Engines averaged about 100 hours of service between overhauls, and the repair cost was about $225 per engine.

In these early postwar years the ASME papers brought out pioneering-thought developments which have more than ordinary interest: "Air-Cooled Airplane Engines" (S. D. Heron, 1921); "Aerial Photography" (G. W. Stevens, 1921); "Bombing of U.S.S. *Ex-Iowa* and the Former German Ships" (F. J. Cleary, 1922); "The Helicopter and the Variable Pitch Propeller" (1922); "Influence of Design on Cost of Operating Airplanes (A. Black, 1922.)

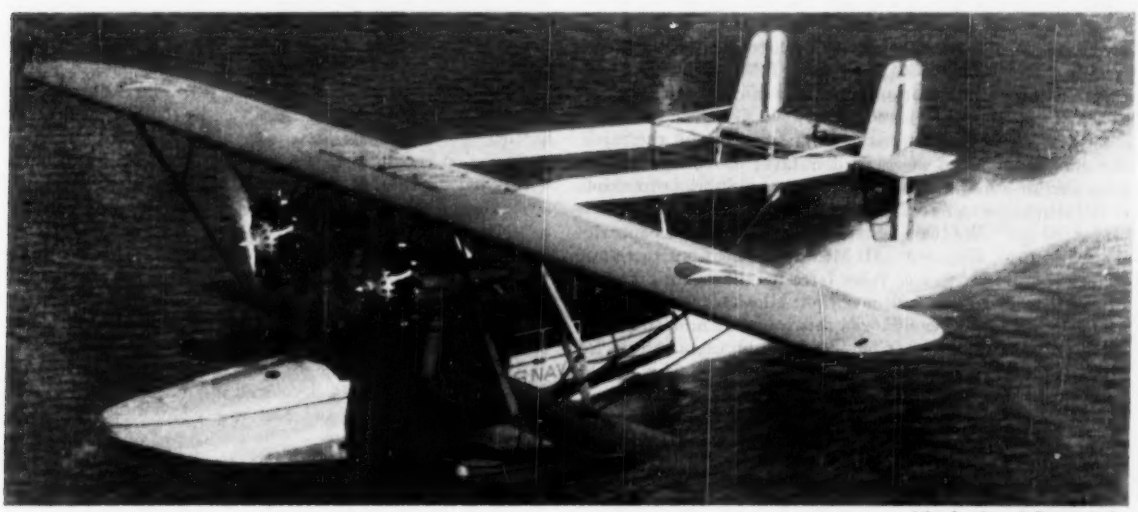
TECHNICAL CONTROVERSIES

The ensuing years witnessed arguments between the protagonists of the airship versus the airplane, wood versus metal structure, air-cooled versus water-cooled power plants, radial versus in-line engines, and flying boats versus landplanes. For these technical controversies the ASME provided the necessary forum. In 1923 Ralph H. Upson, now a professor at the University of Minnesota, discussed the "Airship for Long-Haul Heavy-Traffic Service," a subject which even today could be strongly argued by lighter-than-air experts. He was followed two years later by H. H. Blee on "The Airship and Its Place in Commerce," and in 1926 by Captain E. A. Lehmann, who so tragically lost his life in the Zeppelin "Hindenburg" at Lakehurst. In that paper on the "The Safety of Zeppelin Airship," Captain Lehmann mentioned the safety of using helium in place of hydrogen.

Those who heard this talk will not soon forget the interesting sidelights he presented on Zeppelin operations during World War I when he was lowered in a basket many thousand feet from the Zeppelin while hovering over London. The following year Karl Arnstein followed up with a paper on "Development of Large Commercial Rigid Airships." The present Chief of the Weather Bureau, Commander F. W. Reichelderfer, discussed "Some Aerological Principles Applying to Airship Design and Operation" in 1929. Up to World War II numerous additional papers were presented before the ASME on airship development; on water recovery, stresses, docks, mooring, ground handling, pay load. Admiral C. E. Rosendahl, who is today's leading advocate of the Zeppelin type, presented a paper to the ASME in 1933 on mooring and ground handling. This interest in airships reflected the greater range, pay load, ton-miles capacity at high speed, and reliability of the rigid airship over the then current airplanes. The airship continues to survive for military applications; many of these early campaigners are still alive, and interested.

METAL VERSUS WOOD

The battle between wood and metal for aircraft structures started with lectures by E. B. Carns in 1924-1925, who discussed metal-production problems. And as early as 1927 we see today's problem "Materials for Aircraft Parts Subjected to High Tem-



Sikorsky Aircraft Division of United Aircraft Corporation

THE SIKORSKY S-38, POWERED BY TWO PRATT & WHITNEY 420-HP ENGINES, HAD TOP SPEED OF 125 MPH AND CRUISING SPEED OF 110 MPH

(This plane flew nonstop from Miami to Cristobal, Canal Zone, thus inaugurating Pan-American air-mail service. It was a forerunner of a series of amphibian planes to find wide service and set many world records.)

Sikorsky Aircraft Division of United Aircraft Corporation

USED FOR RESCUE, ASSAULT, AND SUPPLY, THE MARINE SIKORSKY HRS HELICOPTER IS POWERED EITHER BY A PRATT & WHITNEY R-1340 OR WRIGHT R-1300

(With cruising speed of 85 to 90 mph, the HRS can carry a one-ton pay load over 400 miles. Here supplies are being delivered to embattled combat team isolated on rugged Korean mountain peak.)

peratures," by J. B. Johnson. Welded-steel tubular construction was becoming accepted in the early postwar period, so there was an ASME paper on "Fatigue of Welds," by R. R. Moore in 1925.

This Pre-Lindbergh era also saw the development of metal propellers to replace wood. The pioneer in that field, S. A. Reed, gave a paper on "Technical Development of Reed Metal Propeller" before the ASME in 1927. F. W. Caldwell again appeared on an ASME platform in 1930 to discuss the "Development of Drop-Forged Metal Propellers."

In spite of strong arguments by Fokker and others, the battle of metal versus wood was settled in favor of metal, so far as large aircraft were concerned. ASME papers showed this trend. C. B. Fritsche, in an ASME paper of 1929, described his "Metal-clad Airship." Wellwood E. Beall of Boeing, in a paper delivered in 1930, discussed "All-Metal Airplane Construction." This was followed a few years later by the historic Boeing Monomail. The development of light alloys of great strength of course made this possible and this was shown in a paper by H. W. Gillett on "Some Characteristics of Light Alloys for Aircraft" in 1930. Except for a paper defending wood by Fokker about 1932, numerous ASME papers reflected the growing use of metal, culminating in the annual ASME Heavy-Press Programs of today. Nevertheless, we see ASME papers on wood and plywood recurring over the years. Wood is a durable material which has some promise of staging a return engagement in a chemically modified form. If so, the ASME will be ready to give it a hearing.

AIR-COOLED VERSUS LIQUID-COOLED POWER PLANTS

The controversy between proponents of air-cooled power plants versus liquid-cooled power plants was not of such long duration as the one between wood and metal. E. E. Wilson discussed the pros and cons of liquid-cooled engines versus air-cooled engines in his ASME paper of 1925, "Power Plants for U. S. Navy Aircraft." Another ASME paper that same year by S. D. Heron of Wright Field, "Air-Cooled Engine Development," supported the trend in the United States.

DEVELOPMENT OF AIRPLANE ENGINES

Charles L. Lawrance, in an ASME paper in 1929, reviewed the development of the engine designed by the Wright Brothers for their first flights, and others built by his own company and by such pioneers as Glenn H. Curtiss, Fred Duesenberg, Charles King, and Charles M. Manly. Manly built a five-cylinder air-cooled radial engine for Professor Langley's "Aerodrome" in 1902. Lawrance, with the aid of E. T. Jones, S. D. Heron, and others, proceeded with further developments that eventually led to the Wright "Whirlwind" engine. The Curtiss company worked extensively with V-type in-line engines, to meet the wartime need for military aircraft engines. Engineers from the automobile industry led by J. G. Vincent of Packard, E. J. Hall, and others, through tremendous concentrated effort stimulated by war needs, developed in a few weeks the V-type in-line Liberty engine and had it produced in quantity by various automobile plants.

The Wright Whirlwind engine, together with the Pratt & Whitney "Wasp" engine, powered most of the epoch-making flights of the period around 1927, which marked a milestone in the aviation industry from the standpoint of reliable flight.

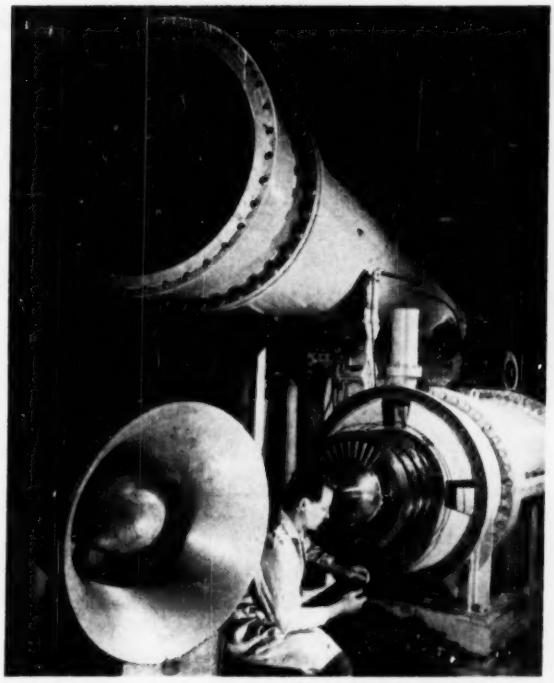
FLYING BOAT VERSUS LANDPLANE

The ASME never chooses sides. So it gave the flying-boat enthusiasts equal opportunities to display their valued opinions

and judgment. Sikorsky in 1929 on "Some Aspects of the Seaplane and the Amphibion"; "Flying Boat Design," by Rohrback (1930); T. P. Wright and G. A. Luburg on "Seaplane Design" (1930); Rumpler in 1931 on "Design and Development of Seaplanes for Transatlantic Service"; and "Trans-Atlantic Air Transport With Particular Reference to Flying Boats," by A. Gouge (1936) led the marine parade.

EFFICIENT OPERATION

The basic problems of flight having been solved, an increasing number of ASME papers were devoted to the efficient operation of aircraft. The first paper by Lent, previously mentioned, was followed five years later by J. E. Whitbeck, Superintendent of the U. S. Air Mail Service. This occurred in 1926, a significant moment in the development of scheduled air transportation, when the Government was withdrawing from scheduled air-mail operation and farming it out to private enterprise. Whitbeck, speaking from five years of practical experience, forecast improved safety records with improved equipment and greater operating efficiency under private control. His paper "Operation of Air Mail and Its Possible Application to Commercial Operations," was the most authoritative of its time. Its optimism generated a glow among the audience which matched the red beard of the speaker. To this day, 27 years later, Whitbeck, now an aviation consultant, has lost none of his zeal or optimism, and his hair is still red. Corollary papers followed on "Maintenance and Depreciation of Airplanes and Engines" (E. W. Dichman, 1926); "Design of Commercial Airplanes" (Mac Short, 1927); "Relation Between Commercial Airplane Design and Commercial Uses of Airplanes" (T. P. Wright, 1929); "Preparation of an Airline for Commercial Operations" (J. G. Ray, 1927); and the very first paper on "Air-Transport Engineering" in 1927 by L. D. Seymour of National Air Transport Company, based on private operation of scheduled air-mail service between New York and Chicago and Chicago and Dallas.



Westinghouse Electric Corporation

A LOW-SPEED WIND TUNNEL IMPOSES LITTLE STRAIN ON JET-ENGINE PARTS BEING TESTED AND PERMITS ENGINEERS TO MAKE QUICK AND RELATIVELY INEXPENSIVE DESIGN CHANGES AS TESTING PROCEEDS

(Here Westinghouse technician prepares jet compressor rotor for series of tests.)

Underwood and Underwood

THE FIRST BLIND FLIGHT WAS MADE AT MITCHEL FIELD IN 1929 BY LT. "JIMMY" DOOLITTLE IN HOODED COCKPIT OF A CONSOLIDATED NY-2

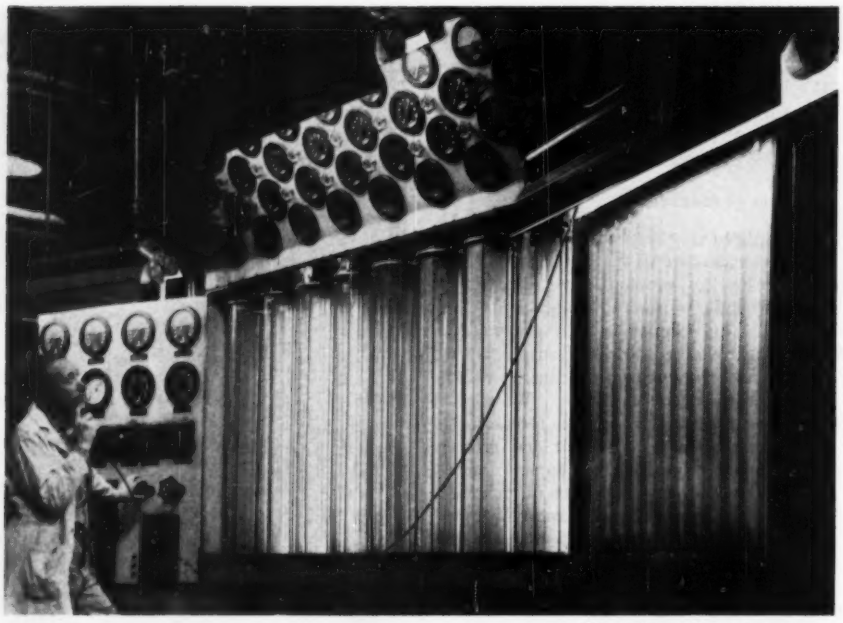
(Using a Sperry Gyro-Horizon and Directional Gyro, he took off, flew 15 miles, and landed blind.)

Two years later P. G. Johnson, well remembered as the architect and organizing genius of Boeing Air Transport and its successor, United Air Transport, and Trans-Canada Air Lines honored the ASME with a paper on "Recent Developments in Air Transport." D. W. Tomlinson followed in 1930 with "Air-Transport Management." Louis Breguet of France contributed "Economics of Air Transport" in 1933. In that same year Hall Hibbard showed the trend that we all associate with his name in air transportation, with a paper "Problems in Fast-Air-Transport Design." Now, twenty years later, he is still delivering lectures on the same subject, but the goal is considerably higher!

Then in 1936 L. G. Fritz (now General Lawrence G. Fritz) and W. A. Hamilton gave the ASME the results of their practical operating experience in "Air-Line Engineering and Maintenance." Thus the ASME supplemented its interest in the purely technical aspects of aircraft development with the practical engineering factors brought to light by actual operating experiences and thought.

NAVIGATION AND COMMUNICATION

Concurrently with developments in materials, performance, and operational techniques came engineering progress in navigation and communications. Here too the ASME provided engineers with opportunities to report their progress and describe their problems. It began with "Principles of the Gyro-Compass," by C. B. Crouse in 1920; "Night-Flying Equipment and



Westinghouse Electric Corporation

THIS TEST STAND ADJOINING WESTINGHOUSE JET-ENGINE TEST CELL IS USED TO CHECK ACCURATELY PERFORMANCE OF ENGINE'S FUEL SYSTEM

(Vertical glass cylinders collect fuel from jet-engine fuel nozzles to check on division of fuel between nozzles. In 500 hours of operation, a jet engine consumes fuel worth half the cost of engine.)

Operation," in 1924, by H. R. Harris (now General Harris) and D. L. Bruner; "Earth-Induction Compass," by G. P. Luckey in 1925; "Applications of Radio in Air Navigation," by J. H. Dellinger in 1927; "Radio Developments Applied to Aircraft," by Dellinger and Diamond in 1929; "Air Navigation," by G. R. Fairlamb, Jr., in 1929; "The Artificial Horizon," by E. A. Sperry, Jr. (he had invented it in 1928 to help Doolittle in his first successful "blind" flight); "Safety in Aerial Navigation Through Radio Communication," by the revered E. T. Allen in 1930; "Sonic Altimeter for Aircraft," by C. W. Rice in 1932; "Study of Light Signals in Aviation and Navigation," by Langmuir and Westendorp in 1932.

ARCTIC OPERATIONS

Problems of Arctic aircraft operation also were discussed in ASME meetings. In 1929 Stefansson, the famous Arctic explorer, gave his "Flight in Arctic Regions." This was followed in 1931 by Bernt Balchen, now Colonel Balchen, who presented "Aviation Lessons of the Antarctic." One remembers his photograph of a staked-down Fairchild in tail-high position facing into a wind of higher velocity than its top speed, with two snow mounds behind it formed by the wind into elliptical shapes demonstrating the distribution of lift over the span of the wing.

SAFETY PROBLEMS

Without safety none of these developments would produce a sound civil-aircraft industry. The continuous interest of Harry F. Guggenheim in air safety was first brought to the attention of engineers in 1927 when he gave his paper on the "Importance of Aerodynamic Safety in Aviation." Among other ideas, he referred to the direct-lift type of aircraft and its significance to safe flight. Frederick Handley Page on "Slotted Wings" that same year and C. G. Mc Cord on "Fire-Prevention Problems" in 1930, showed the early interest of ASME in the ever-fresh problems of safety.

An outstanding development was the introduction of the air-mass system of weather analysis sponsored for airline operation by the Daniel Guggenheim Fund for the Promotion of Aeronautics. C. G. Rossby presented "Meteorological Service for Commercial Airways" in 1927.

Another early and prophetic view of the importance of safety was that given by "Jimmy" Doolittle, then a lieutenant in the Army Air Corps, at an ASME meeting in 1929. He said, in part:

"Safety in flight is the principal problem in aviation. . . . More and better airports are needed. . . . They can be improved by increasing their size and by removing obstacles in the vicinity of the field. . . . A feature to which insufficient attention is given is designing and constructing an airplane so that it crashes well. . . . Many lives have been saved because the cockpit was strong and there was sufficient material between the pilot and the ground to absorb the shock of crashing. . . . We have now, either in our hands or in process of construction, the instruments and equipment required to fly in fog and to land blind on a prepared airdrome. It is only necessary before actual fog operation can be carried on, to co-ordinate these facilities and render them infallible."

The objectives envisioned by the then Lieutenant Doolittle are still among the major problems of today!

ROTATING-WING AIRCRAFT

Although ancient Chinese toymakers and Leonardo da Vinci are generally credited with the invention of the lifting airscrew, the earliest reference to rotating-wing aircraft in ASME publications is a paper by an unnamed writer in the September, 1922, issue of MECHANICAL ENGINEERING titled

"The Helicopter and the Variable-Pitch Propeller." It reviewed the fundamental problems and traced American and European developments in vertical flight and the probabilities of applying the principles of varying the pitch of propellers to vertical and horizontal airscrews. Alexander Klemin presented his "Introduction to the Helicopter" at the ASME meeting in 1924.

In 1929, Señor de la Cierva presented his paper "Theory of the Autogiro," at a meeting of the ASME Aeronautic Division at Cleveland, Ohio. Heinrich Focke's study of the "Development of the Focke Helicopter" at the ASME Annual Meeting of 1938, covered progress in Europe regarding power-driven and auto-rotating airscrews, including aircraft of both types made by his own company.

Dr. Sikorsky addressed the ASME in 1929 and 1939 on airplanes and industrial preparedness and in 1944 discussed direct-lift aircraft before the Society.

COMMERCIAL DEVELOPMENTS

The "Lindbergh Era" witnessed an expansion of interest in commercial air transportation, with ASME engineering studies extending to weather conditions, instruments, navigation, communications, traffic control, airport operation, flying instruction, management, maintenance, comfort and safety, as well as problems of design and construction of aircraft.

THE YEARS OF LOW ACTIVITY

The financial handicaps imposed by the depressed business conditions prevailing from 1933 to 1939 interfered somewhat with the development of commercial aviation, but increasing interest in military aviation absorbed a large part of the slack. Few new commercial designs appeared in the early years because of the overproduction of aircraft in preceding periods, and because of financial considerations. However, it was recognized by engineers that existing aircraft were becoming obsolete. Commercial air traffic increased in 1933 despite the low state of business. ASME papers showed that the year marked a turning point in air transport, and new commercial aircraft designs appeared with improved landing gear, propellers, control equipment, and supercharged engines. Progress was made in instrument flying, airports, airways and traffic control, and in comfort and dependability. Use of the Sperry auto-pilot and other instruments relieved the pilot of much of the physical strain of flying. Meteorological facilities were expanded. Not much new information about aerodynamics appeared in the middle years of the period, work being concentrated largely on the development of present knowledge, in all of which ASME members took a prominent part.

Military designs accentuated higher speeds, greater power, streamlining, and stronger structures. Heavy, multiengined bombers and high-performance fighters appeared under the expanding military and naval programs. All these developments were mirrored by ASME papers in these years.

PRODUCTION

The ASME has many papers on record covering production problems in building aircraft and engines. In 1928 Walter H. Beech gave his paper "Problems of Commercial Plane Production" and Jerome Lederer in 1928 gave probably the first paper ever to describe how an automobile plant could be converted for aircraft construction in "Some Notes on Airplane Production." This described his experiences in helping convert the Velie automobile plant to the construction of the Monocoupe. These papers, along with papers by Porterfield, Bellanca, and Beisel on production, reflected the influence of the Lindbergh flight on aviation development.

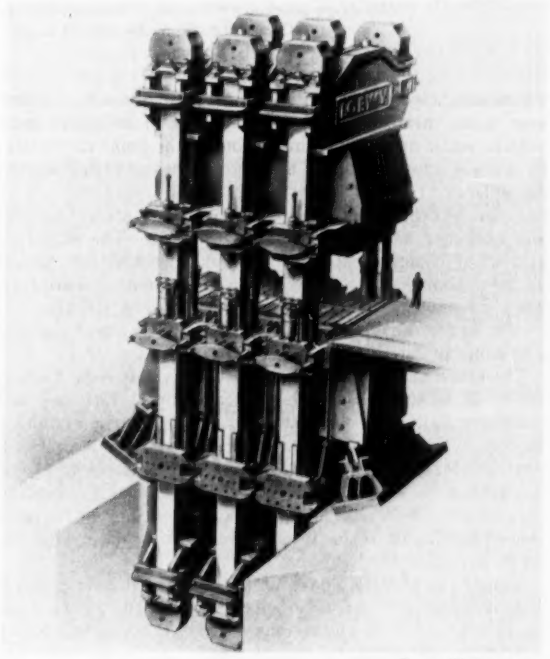
PERSONAGES

Many persons important to the development of aviation have been mentioned in this brief summary of the part the ASME has played in providing the industry with a means to exchange ideas and inform itself of significant technical developments. Breguet, Handley Page, Doolittle, Sperry, Moss, Durand, Sikorsky, Langmuir, Lawrance, and T. P. Wright have been mentioned. There are a host of others who contributed papers, who have been equally important; Millikan; von Kármán, Zahm, Bassett, E. P. Warner, Lanphier, E. A. Deeds, and Earl Ovington, to cite a few. However, just as the reference to those we did mention is not a fair criterion of their importance to aviation development, the omission of papers by many others does not mean that their efforts were less important. So vast is the background of ASME activities in aviation, it is impossible to do justice to all.

CO-OPERATION WITH OTHER SOCIETIES

The ASME has collaborated with other engineering societies on matters aeronautic. The Guggenheim medal is awarded jointly by the ASME, IAS, and SAE. The Heavy-Press Program featured at ASME meetings in recent years and the Air Cargo sessions are also accomplished with the wholehearted co-operation of these other organizations.

In 1916 the Society of Aeronautic Engineers merged with the Society of Automobile Engineers and in 1917 formed the Society of Automotive Engineers. But the first official SAE notice of



Loewy-Hydropress

THE 50,000-TON CAPACITY HYDRAULIC CLOSED DIE FORGING PRESS, DESIGNED AND BEING BUILT BY LOEWY-HYDROPRESS FOR THE U. S. AIR FORCE HEAVY-PRESS PROGRAM, WILL LOOK SOMETHING LIKE THIS

(A 1:24 scale model has been made that can be disassembled to familiarize erection supervisors with assembly problems. The six vertical columns (tie rods) are 110 ft long and weigh 320 tons each. The press will be operated by Wyman-Gordon, North Grafton, Mass.)

Standard Oil Company (N. J.)

CARGO BEING LOADED ABOARD SEABOARD & WESTERN DC-4 AT IDLEWILD AIRPORT

(Air cargo continues to assume increasing importance in handling of domestic and international freight. Over 250 million ton-miles of cargo were handled by air in the U. S. last year.)

aeronautics appeared in the 1911 SAE Transactions. In that year, some members urged the launching of an aeronautical branch, while others thought it more to the point to prohibit by law the operation of the flimsy contraptions then described as airplanes.

A year before the merger, a paper on "Aeronautical Engines" was presented at the 1915 Summer Meeting. The following year, three papers were presented. And thereafter few Annual or Semi-Annual Meetings lacked a discussion of aeronautic work. Following the merger an Aircraft-Engine Division was formed under the General Standards Committee, and the next year came an Aircraft Division.

The first SAE aeronautic meeting was held at New York in 1917. Four sections—Detroit, Metropolitan, Chicago, and Southern California—organized local aeronautic activities. Finally, when the Society was reorganized on a Professional Activity basis in 1929, the Council gave additional formal recognition to Aircraft and Aircraft Engines as Professional Activities. The Aircraft-Engine Activity became the Aircraft-Powerplant Activity in 1945, in recognition of turbine and jet power-plant developments.

In 1932 the ASME Aeronautic Division extended its greetings and co-operation to the newly organized Institute of the Aeronautical Sciences. It also recommended to the American Standards Association that the Aircraft Safety Code be revised. The Division organized an Industrial Aerodynamics Committee in 1934, to co-ordinate and stimulate research and present technical papers in that field. Active assistance was given by the Division to the ASME Committee on Aircraft Safety and Inspection, the Aviation Committee of the American Engineering Council, as well as the SAE and the IAS throughout the 1934–1937 period.

Recognizing the need for a professional society that could serve the primary interests of the aeronautical technicians and scientists, a small group of farsighted men banded together in 1932 to bring such a society into being. The groundwork and conception of the organization had been started as early as 1928 by Lester D. Gardner and Jerome C. Hunsaker (who was to become a vice-president of ASME a few years later), although its formation was considered inadvisable at that time.

With the charter of the long-established and successful Royal Aeronautical Society at hand and the advice and experiences of its respected secretary, Capt. J. Lawrence Pritchard, to guide them, they discussed the idea with numerous leading aviation figures of this country. As a result the "Institute of the Aeronautical Sciences, Inc.," a name suggested by Edward P. Warner, became an official corporation of the State of New York on October 15, 1932. In the first public statement issued shortly thereafter, the first president, J. C. Hunsaker, said:

"The purpose of the Institute is to advance the aeronautical sciences. Aeronautics in its various activities embraces many different branches of science. The Institute will supplement the work of other organizations that have to do with the industrial, sport, and engineering phases of flying. . . . It will bring together, for the exchange and discussion of aeronautical problems, experts now engaged in many fields. . . . The Institute will provide an organization for the encouragement and dissemination of such scientific activity."

SPECIAL PUBLICATIONS

Aeronautical Engineering. The first periodical or magazine-type publication of professional standing published by the ASME was *Aeronautical Engineering*. It appeared quarterly from 1929 to 1931 and contained the articles and papers which were printed as part of Transactions. Copies were sent to members in the Aeronautic Division in the belief that they might desire a small, specialized edition. This was the only purely technical

periodical published for the aviation industry by a technical organization.

Aeronautical Dictionary. To facilitate the reading and understanding of technical aeronautical books and papers in foreign languages, the ASME published in 1929 a dictionary of aeronautical terms in English, French, and German, compiled by J. F. Vanier. The compiler was a noted linguist who had been a translator of technical data in Europe for several years before joining the Army Air Corps Materiel Division.

BROADENED ASME FIELD

Beginning in 1938, the ASME Aeronautic Division established a definite trend in its activities toward the broader field of application of aerodynamics to other industries. The reciprocal, i.e., the application of progress in other engineering fields to aviation, also was developed. At the 1938 Annual Meeting of the ASME a paper on the first successful helicopter was given by its inventor, Heinrich Focke. Several papers on the autogiro also were presented.

WORLD WAR II

The crisis in Europe in 1939 caused the cancellation of a proposed British-American Engineering Congress at which papers on economical airline equipment and on transatlantic air transport, with special reference to flying boats, were to have been delivered. Attention of the Society was directed largely to matters of national defense, and Dr. Sikorsky presented a paper on that subject. The paper on transatlantic air transport was given in 1940 at meetings in New York and Los Angeles.

CONVERSION TO WAR

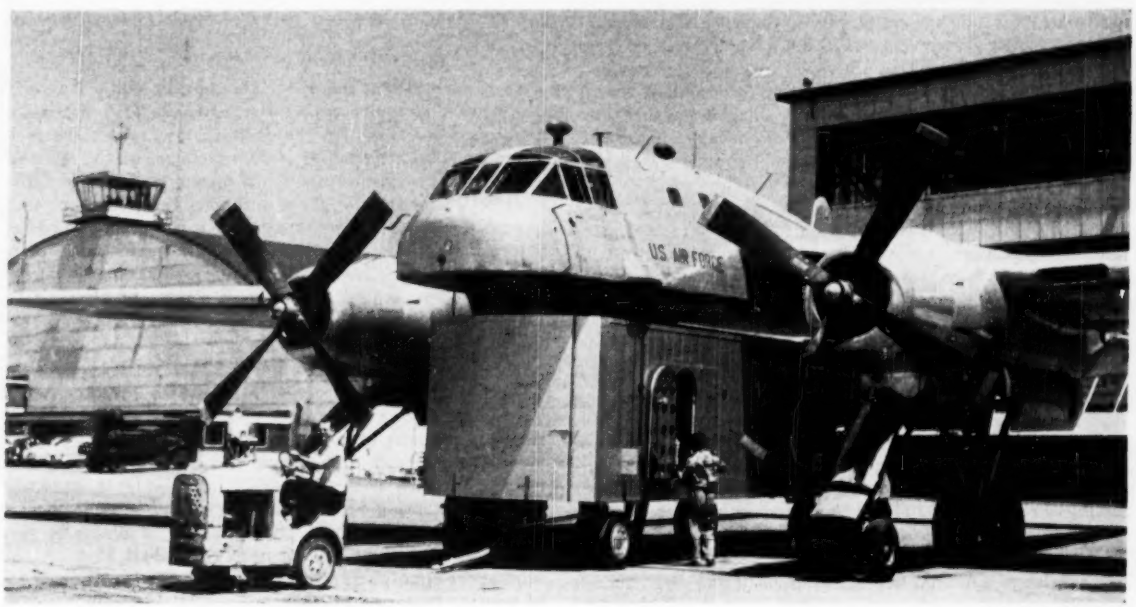
Entrance of the U. S. into the war in 1941 brought a great expansion of the aviation industry and of the activities of the ASME. The Aviation Division was reorganized to meet the enhanced responsibilities of the Society and the industry. An aviation liaison representative assigned to each Division facilitated exchange of ideas, information, and experience, to expedite production and improve the performance of American aircraft.

Up to the end of 1941 "Defense" was the keynote of the engineering profession as well as of other groups, but on December 8 conversion to the full-scale war effort began. In the words of the ASME report for 1942 ". . . it gave those in industry increased opportunity to devote still further energy to the business of producing the engines of transportation and of combat, without which no modern struggle can be fought, and with which the issue must be settled on the battlefield." All Divisions redoubled their efforts, but special mention was made of the rapid progress of the Aviation Division, the Production Engineering Division, and the Railroad Division.

Aviation Division Expansion. In keeping with the broadened scope of the Aviation Division of the ASME under war conditions in 1941–1942, an expanded committee organization was established, comprising an Executive Committee with a subcommittee on plastic-plywood construction of aircraft; a Liaison General Committee on applied mechanics, diesel engines, heat transfer, hydraulics, instruments, production engineering, management, plastics, research, rubber, safety, textiles, wood industries, and metals. Liaison representatives were assigned in local sections in aviation industrial centers.

Aviation meetings were held in local sections and student branches and co-operation was extended to other divisions and research units. Objectives of the Division were expanded to include dissemination of all permissible technical information, sponsoring of aviation meetings and educational research projects, fostering of aviation contacts, publication of more papers, and extension of Pacific Coast activities.

The Division participated in three national meetings of the Society and presented 14 papers on various phases of aircraft-production methods and plants, materials, engine filters, air-carrier terminals, management, and design.



Fairchild Aircraft

A PROTOTYPE OF THINGS TO COME IS THIS SEMITRAILER OF THE AIR

(In the future, it is expected that trailers like this will be carried long distances by air, and shorter distances by helicopter, train, and truck. Here a Fairchild XC-120 prepares to pick up its roadable pack. Next step is opening the front doors to present an aerodynamically clean configuration when airborne. The wheel gear of the roadable pack stores inside during flight.)

War Production. In the 1942–1943 period, the problems of war, industry, and of mechanical engineers shifted from the tasks of designing for production to those of achieving great output, with increased emphasis on greater production per man-hour.

The Aviation Division added a subcommittee on Biomechanics (safety of pilot and crew in crashes) and continued its cooperation with local sections, other Divisions of the Society, and with Government establishments. Six aviation sessions were held at the Annual Meeting, one at the Fall Meeting, two at the Spring Meeting, and 18 at the Semi-Annual Meeting. Altogether, 72 papers were presented on aviation subjects at national meetings within the year.

The 1943–1944 period brought a favorable turn of the tide of war, indicating that, while heavy production must continue, plans should be made for the eventual peace. With 2500 members of the Society in the armed forces and most of the remainder active in production work, the ASME gave a full measure of support to the war effort. At four national meetings, there were 28 aviation sessions at which 82 papers on aviation were presented.

25th Anniversary of Aviation Division. The year 1945 marked the 25th Anniversary of the Aviation Division (originally called Aeronautic Division). A commemorative leaflet showed that the Division had become one of the largest and most active in the Society, amounting almost to a society itself. Of the 18,500 members of the ASME, more than 3500 engineers were registered in the Aviation Division and 2000 of those indicated that aviation was their major field. The Division differed from most others because it represented an entire industry instead of special or particular branches of an industry.

With the ending of the war in 1945, the ASME turned its attention to the problems of reconversion and adjustment to peacetime work.

POSTWORLD WAR II ERA

During the first postwar year the Society made conspicuous contributions to important problems, domestic and international. Nuclear energy and gas turbines had prominent parts in meeting programs. The American Rocket Society, which had been fostered by the ASME, became fully affiliated with the ASME, thereby marking another chapter in the close association of the ASME with air developments. Noise and comfort studies, biomechanics, and weight control were added to the regular projects of the Aviation Division.

And so the aviation work of the ASME proceeded during 1947–1949, with active participation in major meetings, conferences, inspections, and visits to Government and industrial installations, and special sessions on current problems involving gas turbines.

AIR CARGO

The fiscal year ending September 30, 1952, was the third consecutive year of effort to stimulate participation in the growing field of air-cargo handling and air-terminal facilities.

In 1949 the engineers of the ASME foresaw the growth of the air-cargo business and laid plans to serve that field. An Air-Cargo Day was inaugurated at the 1949 Annual Meeting, consisting of two sessions and an inspection trip, sponsored jointly by the Aviation Division and the Materials Handling Division of the ASME, and by the SAE and IAS. There was an outstanding exhibit of air-cargo terminal equipment and cargo-aircraft models.

At the 1950 Annual Meeting, five of the nine papers dealt with cargo operations and cargo aircraft. Jervis C. Webb discussed "Overhead Floor Tow Conveyors for Cargo Operations," and George E. Hagemann told about "What's New in Cargo Terminals." The versatility and performance of the Boeing Stratofreighter were related, and the present and future characteristics of military cargo aircraft were presented by an Air Force officer. The national-defense potentialities of the C-124A and DC-6A cargo transports were outlined.

At the Annual Meeting in 1951 there were papers on freight handling. John R. Alison described the "Transit Van System of Transportation," by which the time and costs of loading and handling freight could be reduced. Lieutenant-Colonel Ivan E. Campbell of the U. S. Air Force discussed the "Air-Freight Handling Technique at Kelly Air Force Base."

For the Semi-Annual Meeting at Toronto, the Aviation Division arranged for a number of papers by leading aeronautical engineers of Canada and England. One paper which caused much interest was a discussion of the "Turbo-Jet Transports With Special Reference to the Comet," by Wallace G. Townley. Henry Knowler of Saunders-Roe, Ltd., came from England to talk about "The Flying Boat With Special Reference to the 'Princess.'"

A full day of the 1952 Annual Meeting was devoted to air-cargo matters. Air-cargo terminal requirements were discussed by a panel which considered the matter from the viewpoint of the Civil Aeronautics Administration, of the airport operator, of the aircraft manufacturer, and of the airlines carrying both passengers and freight, and freight only. A symposium on international air-cargo trends was conducted by representatives of American, Australian, and European airlines. The panel discussion on air-cargo terminal requirements brought out a lively discussion of the relative merits of an ideal freight plane, as to whether it should be of truck-bed height. Ian H. Grabowsky came over from Australia to tell how the air lift of beef was changing the whole economy of a part of Australia. Another symposium at the 1952 Meeting considered air transportability with respect to the requirements of the Navy, the Air Force, the Military Air Transport Service, and an all-cargo airline. These sessions were attended by over 400 persons, including some 75 from the Armed Services and several from abroad.

TURBOJET DEVELOPMENT

It was natural that the ASME should take a special interest also in turbojet applications for aircraft. In 1950 mechanical engineers were thinking ahead to the supersonic speeds of the future, as evidenced by studies presented at the 1950 Annual Meeting on high-speed aerodynamic problems of turbojet installations and designs of turbojet engines for supersonic speeds. Two papers and a symposium at the 1950 Spring Meeting considered naval uses of jet aircraft, performance of jet engines, and anti-icing problems of gas turbines. Further interest was shown by papers on jet-engine problems at the 1951 Annual, Semi-Annual, and Fall Meetings.

FORGING AND EXTRUSION PROBLEMS

Special attention at the 1952 Annual Meeting was given to light-metal forging and extrusion problems in aircraft construction, by engineers from an aircraft manufacturer, a builder of presses, a producer of forgings, and two suppliers of light metals.

The 1952 Spring Meeting at Seattle gave consideration to press forgings and panel constructions, landing-gear drop tests, and gas-turbine development. The Fall Meeting dealt with upper-atmosphere research, cosmic radiation, and a review of aviation progress in 1952.

HEAVY-PRESS PROGRAM

The Aviation Division, Machine Design Division, Metals Engineering Division, and Production Engineering Division of

ASME have joined with the American Institute of Mining and Metallurgical Engineers, the Institute of the Aeronautical Sciences, and the Society of Automotive Engineers in sponsoring discussions of the Air Force Heavy-Press Program for light metals. The program involves the design and building of huge presses used for forming very large integral sections of air-frames such as wing and fuselage members, as well as landing-gear components and other parts. Such structures are essential for the high-strength and light-weight requirements of present and future supersonic aircraft. It has been found that forgings and extrusions are most suitable for making these parts, which must have precision of form, great strength, light weight, as well as the lowest possible cost.

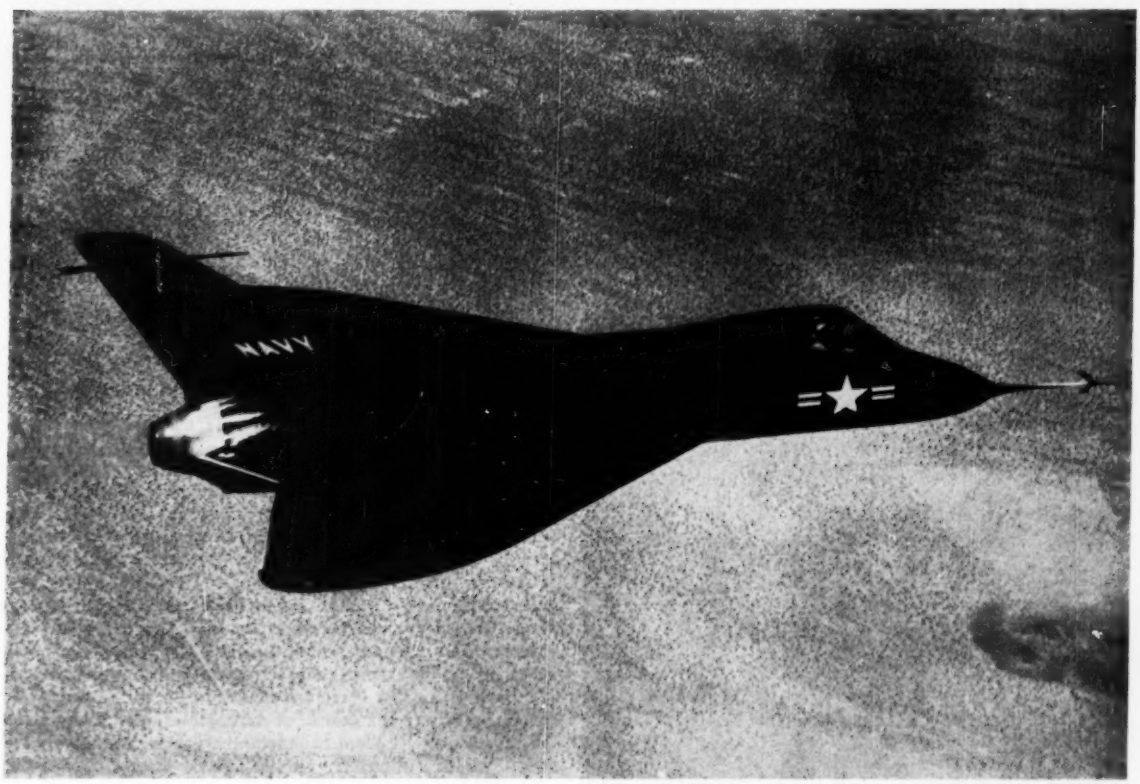
Such presses, to exert 20,000 tons of pressure, weigh 11,000-000 lb with their auxiliary equipment, and stand 27 ft high. Forging presses are now being built in capacities of 35,000 tons and 50,000 tons. As an example of the saving which can be expected from the use of such heavy presses, Douglas Aircraft Company recently reported that whereas the inboard rib of a swept-wing airplane used to start with a hand-forged billet weighing 1000 pounds, that had to be machined down to the finished piece weighing about 200 pounds, and requiring many man-hours of work, with the 35,000-ton press a similar part weighing about 210 pounds can be "hammered" out by the press in a single operation. A spar approximately 30 feet long can be made in a single piece. The program will require the investment of a half-billion dollars, which can be provided only through Government sources, and is expected to be the largest industrial-processing program in the history of this nation. It probably represents the most rapid and far-reaching advance in the art of metal processing in a relatively brief period of time that has occurred in our industrial history.

SUCCESSOR OF THE AIRPLANE?

Thus has the ASME spanned the entire history of aviation, from balloons to rockets, from stick and wire to whole forged spars. By its fostering of the American Rocket Society and by participating in its work, the ASME has taken a prominent part in the development of what may become the successor of the airplane, and in the conquest of interplanetary space as it did in the conquest of the air.

So from 1881 to the fiftieth anniversary of powered flight in 1953, the ASME has performed faithfully its mission to fulfill the vision expressed by its first president in his address of 1881, in which he quoted the prophetic words written by Dr. Erasmus Darwin in 1781:

> "Soon shall thy arm, unconquered steam, afar
> Drag the slow barge or drive the rapid car,
> Or, on wide-waving wings expanded bear
> The flying chariot through the field of air."



Douglas Aircraft Company

THE DOUGLAS F4D SKYRAY JET INTERCEPTOR IS DESIGNED TO BE CATAPULTED FROM NAVY CARRIERS AND CLIMB RAPIDLY TO UPPER ATMOSPHERE TO INTERCEPT ENEMY ATTACKERS

(It was this plane, powered by a single Westinghouse J-40 jet engine with afterburner, that set the recently established world's official airplane speed record of 753.4 mph.)

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Mechanized Electronics Production

THE development of a production system—code-named Project Tinkertoy—which turns out complete units from electronic components and offers industry an entirely new pattern of manufacturing short cuts, was announced by the Navy Bureau of Aeronautics and the National Bureau of Standards in Washington, D. C., recently.

The process makes possible the manufacture of certain electronic equipment through mechanized assembly of bulk or raw materials with a minimum of hand labor and at considerable saving in time.

The basic element in the NBS modular design system is a ceramic wafer of electrical grade steatite with three notches equally spaced on each side. On the two faces of the wafer are assembled resistors, capacitors, inductors, tube sockets, and other electrical components.

A series of these wafers when stacked one above the other, notches aligned and conductors fitted, interlock in a wide variety of circuit arrangements. Wire conductors serve as structural supports as well as circuit conductors. The end product, a plate assembly of stacked wafers, all mechanically wired and soldered, may be fitted into any suitable mechanical structure. Electrical connection may be made to it by several methods. Perfection of a plug-in connection, promising a practical method of utilizing the plate assembly, will enable relatively untrained personnel to replace quickly any defective part of an electronic unit.

A complex submarine-detection device, which is needed in large numbers in time of war, was selected for a sample test.

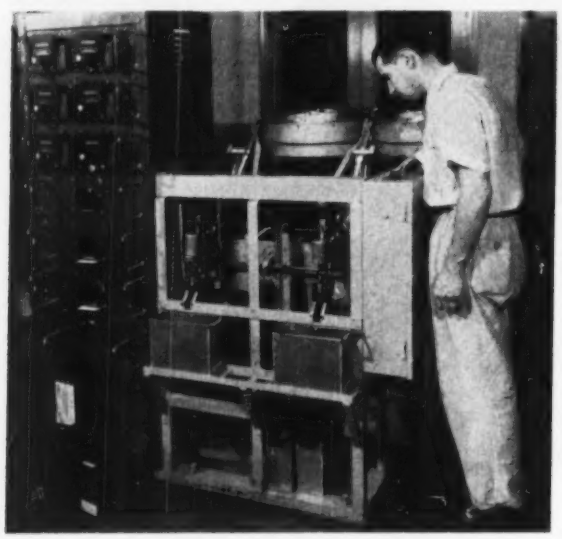


FIG. 1 PATTERN INSPECTION

(Conducting circuits are inspected automatically. Punched cards set up appropriate test circuits in this electronic inspection.)

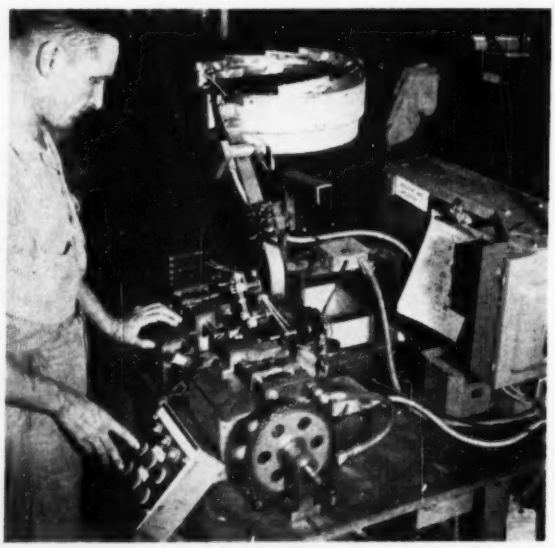


FIG. 2 RESISTOR-TAPE APPLICATION

(One or two resistor tapes automatically may be applied to a wafer surface. One-half-inch segments are severed from a roll and pressed between silver electrodes.)

Keeping to the same size and performance requirements, the new machine-made modules were substituted for the previous maze of wiring, resistors, capacitors, etc.

After a sample device passed the tests completely, a contract was awarded to the Kaiser Electronics Division of the Willys Motors, Inc., to manufacture the device on the new machines in order to determine whether it could be mass-produced. Delivery of the first detection devices of the initial order were made recently to the Bureau of Aeronautics, which hopes that private firms will adapt the method to their productive needs and, by adding their know-how, improve on it.

MPE PRODUCTION SYSTEM

The MPE (Mechanized Production of Electronics) system largely utilizes noncritical raw materials. The ceramic wafers—$^{7}/_{8}$ in. sq × $^{1}/_{16}$ in. thick—are produced directly in quantity from the raw ingredients. Ceramic capacitors are

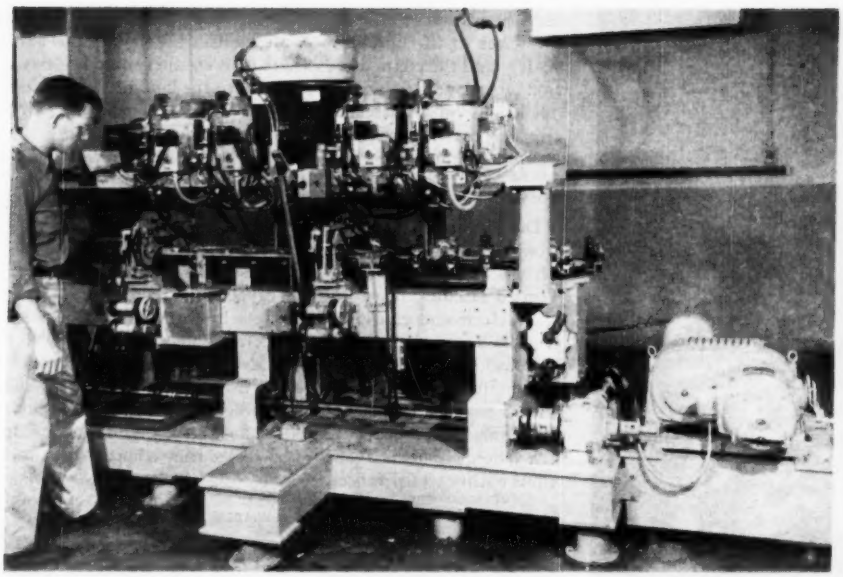


FIG. 3 CAPACITOR-WAFER ASSEMBLY

(One or two titanate capacitor bodies are automatically bonded to each wafer surface. Machine automatically orients, assembles, and bonds capacitors to wafers.)

produced in a similar fashion. Another part of the line produces adhesive-tape resistors.

These and other basic parts are fed into the production line. The appropriate circuits are printed by automatic machines. The circuit configuration is achieved through photographic processing. Quality control is established by automatic inspection, directed by information prepared in punched-card form. Special components, not suitable for "printing" techniques, can be incorporated into the modules. Automatic physical and electrical inspection is provided for in the production line.

The MPE system is based on the use of bulk or semiprocessed materials, and the line produces all the large-quantity parts except for the tubes. The pilot plant is designed for a production goal of 1000 modules per hr. Joining modules together to form subassemblies may also be accomplished by machines.

WAFER PRODUCTION

The wafers and tube sockets are made from a controlled combination of talc, kaolin, and barium carbonate. The three minerals are mixed, filtered, and dried to a flour. The flour mixture is further refined and then loaded into a mechanical press which stamps out the wafers and tube sockets and cuts the riser-wire notches. The press can produce about 2800 pieces per hr. From the press the wafers are sent through a tunnel kiln, operating at 2300 F, which cures the ceramic in nine hours. After curing, the wafers are mechanically gaged, and all pieces which do not fit within close tolerances are rejected.

COMPONENT PRODUCTION

The titanate capacitor body is manufactured in much the same manner as the ceramic wafers. The capacitor is nonporous ceramic composed usually of magnesium, barium, calcium, and strontium titanates of high purity. It is about $^1/_2$ in. sq and 0.02 in. thick. The capacity values vary from 7.0 micromicrofarads to 0.01 microfarad. Raw-material batches weighing about five pounds will produce about 100,000 capacitors, about 80 per cent of them acceptable.

The materials required for manufacture of tape resistors are a heat-resistant asbestos paper tape known as Quinterra, polyethylene tape, carbon black or graphite, resin, and a solvent. The resistor formulation, consisting of a mixture of the carbon, resin, and solvent, is ground to a very fine adhesive powder. The compound is then sprayed on a loop of Quinterra tape. Immediately after the compound is sprayed on, a protective coating of polyethylene tape is applied over the resistor compound. The tape is slit into five or six narrow strips and stored on rolls in a refrigerator. A 75-ft roll of tape will produce over 10,000 resistors. The tape resistors produced have a range from 10 ohms to 10 megohms. They will hold their rated resistance within ± 10 per cent up to temperatures near 400 F and are capable of $^1/_4$-watt power dissipation at the operating temperature.

METALIZING

Metalizing is the name given to a series of operations in

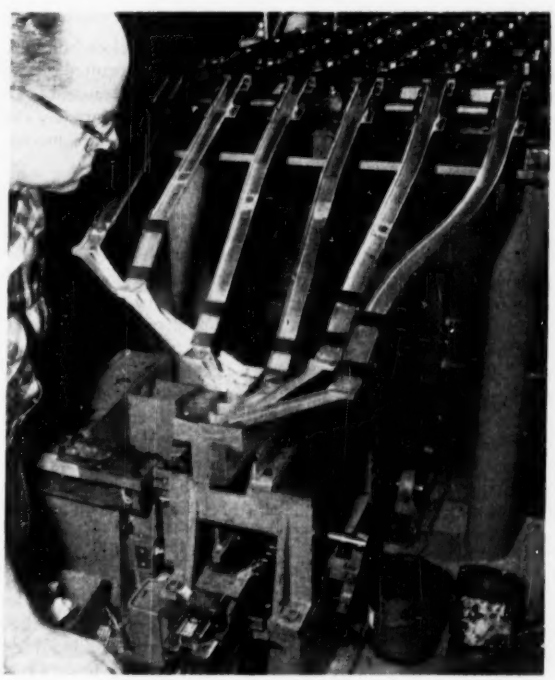


FIG. 4 MODULE ASSEMBLER

(Parts-mounted wafers are loaded in vibratory bowl feeders that issue single, oriented wafers into a stacking jig. Simultaneous soldering operations bond riser wires to the wafer notches.)

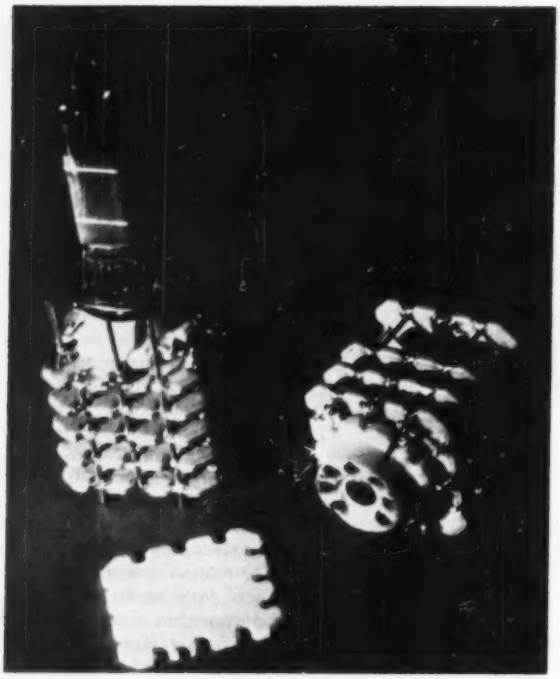


FIG. 5 MPE MODULES

(The product of the Mechanized Production of Electronics is a stack of four to six steatite wafers, upon which are mounted silver conducting circuits and tape resistors, titanate capacitors, and other miniaturized electronic parts.)

which appropriate sections of the wafer or capacitor body are silver-painted. During these stages, circuits are printed on the wafers, the notches are coated, the conducting surfaces and leads are applied to capacitors, the bodies are cured in a furnace, and the circuits are inspected. All of the operations are mechanized.

COMPONENTS ASSEMBLY

Once the wafers and the components have been made and metalized, the next step is their joining. Machines are used to apply up to two capacitors to each side of a wafer. Other machines apply either one or two resistors to each side of a wafer. Rolls of resistor tape are mounted on a machine that automatically cuts the tape into $\frac{1}{2}$-in. strips, presses the tape between printed electrodes on a wafer, applies pressure, and ejects the completed piece. Tube sockets are also mounted on their appropriate wafers so that the pins will connect with the suitable notches.

After many of the steps in the components assembly process, operations such as soldering and tinning must be performed. These are accomplished automatically by utilizing such methods as induction heating and dip tinning.

MODULE ASSEMBLY

Uniform wafer-mounted component parts, including wafer-mounted coils, toroids, potentiometers, and crystals are now ready for assembly. The complete assembly of the module is accomplished in a single machine. Six vibratory feeders issue the wafers to a loading device that holds the wafers in an upright position between specially designed jaws. A chain drive carries the jig to a soldering position at which six riser wires are guided into appropriate notches, three on a side. The mechanism brings soldering irons in contact with the unit and bonds the wires to the notches. A mechanism next turns the unit 90 deg, and the chain drive carries it to another soldering position where six more wires are bonded to the module. The final operations on an assembled module consist of automatically clipping the riser wires at specified positions and testing the completed units.

AUTOMATIC INSPECTION

During each stage in the mechanized production of electronics, provision is made for 100 per cent automatic inspection. This is both a physical gaging and an electronic comparison. Printed circuits, resistors, and capacitors are compared with their electronic equivalents both before and after assembly. This is accomplished by use of electronic computers, bridge circuits, and other comparison devices. The testing "code" is contained on the punched cards which were prepared by the design engineer and have accompanied the wafers all through the production process. After the final assembly of the module the whole circuit is again tested to see that it meets specifications within set tolerances.

FINAL ASSEMBLY

The final operation may not necessarily be considered part of the Project-Tinkertoy plant. Normally, a set of modules (sometimes as many as ten) are mounted on or between copper-clad base plates. Circuits have been etched into the copper surface and connect the riser wires of the several modules to form a complete electronic circuit. Several such plate assemblies may form an equipment. One base plate with six modules, for instance, contains all the necessary circuits to make a six-tube radio receiver function properly.

Transmission-Plant Fire

VITAL fire-protection lessons emerged from General Motor's Detroit transmission-plant fire, according to the October, 1953, issue of *Factory Mutual Record*. The fire, said to be the largest fire loss in the history of American industry, destroyed the large structure in about 14 hours. Property damage was estimated at $40 million. This plant had been the sole source of Hydra-Matic automobile transmissions—which are used not only in cars of GM's own division, but in cars of other manufacturers as well.

The Factory Mutuals had no insurance on this particular General Motors plant, and had made no inspections, but following the fire they were able to visit the plant and obtain available information; the object—to present an authoritative account of the fire and its lessons to industry. The *Factory Mutual Record* account follows:

The huge building, covering $1\frac{1}{2}$ million sq ft, or nearly 35 acres, was comparatively new, having been started in 1949. It was mainly one story with a flat roof. There were no fire cutoffs. The roof was steel deck, supported by I-beams on steel trusses, which in turn were supported by large H-columns. Roofing consisted mainly of glass-wool insulation, with some celotex insulation, over two layers of asphalt-saturated felt, covered with three layers of roll roofing felt, hot tar, and slag.

PROCESS HAZARDS

Typical plant operations were dry machining of castings, automatic screw machining, heat-treating, oil quenching, gear cutting with high-flash oil, rustproofing with oil, and tool grinding. These operations are not uncommon to mass-production machine shops.

Widespread use of mineral cutting, quenching, and rust-

proofing oils and high production rates resulted in a large total amount of flammable liquid within the building.

There were three large rustproofing dip tanks in the south end of the building. The tank near the fire's origin contained 450 gal of rust-preventative oil, having a flash point of from 100 to 105 deg.

A monorail conveyer carried metal parts on hooks through the tank. It then rose to a 14-ft elevation, ran 40 ft south of the tank, turned and traveled to a point 80 ft north of the tank. Here it dipped down to floor level for unloading and then returned to the tank. About three feet below the conveyer, a metal trough two feet wide caught the drippage.

AUTOMATIC PROTECTION

The dip tanks and ten feet of the drainboard on either side were protected by a fixed CO_2 system of two 100-lb cylinders. There were two 950-gal oil-quench tanks in the vicinity, also protected by CO_2. There were no sprinklers in the area.

Only a small part of the entire manufacturing area was sprinklered—estimates varying from 10 to 20 per cent. These were generally along the west wall. Contracts had been let, however, to install sprinklers in some additional locations.

The ten-inch yard loop, supplied by a city main, was backed up by a 200,000-gal gravity tank of which 100,000 gal were reserved for fire. Yard hydrants were spaced around the building, but due to the unusual width of the structure, central areas were nearly 500 ft from hydrants.

FIRE STARTS

Employees of a plumbing contractor were using an acetylene torch to remove a two-inch steam-condensate pipe. A four-man crew had been working in the area for some time, with one of them acting as a fire watcher equipped with a 20-lb CO_2 extinguisher.

The welder had just burned through the pipe when the watcher on the floor noticed fire in the trough. The fire at this point was 11 ft above the floor and only 15 ft from the dip tank. The conveyer was stopped at once.

As the fire started to spread, the contractor's men and plant employees began using 20-lb CO_2 extinguishers. The fire, however, kept gaining between applications of the gas. A foreman used a 150-lb dry-chemical extinguisher but, due to the elevated location of the fire and the fact that the men were working from a ladder, extinguishment with the facilities available became impossible.

Dense black smoke soon seriously hampered the fire-fighting activities. In a short time, the trough buckled, spilling burning oil on the floor.

A small hose stream was used on the floor fire. About five minutes after the fire started, the lights in the area went out and power for exhaust ventilation failed. Within minutes, the blaze had traveled along 120 ft of the drip trough, spreading intense heat. The heavy smoke caused employees to abandon the building. From this time on, all fire fighting was done from outside the building.

BUILDING DOOMED

The public fire department at nearby Livonia was notified about six minutes after the fire's start. Three pieces of Livonia equipment were immediately dispatched and calls sent out for help from six surrounding communities and Detroit.

Intense heat and heavy smoke completely sealed off entry to the burning building. Pumpers took suction from yard hydrants. The water pressure in the public mains held up satisfactorily, but the large draft from the numerous hose streams on the yard system and from opened sprinklers, as well as the loss of water from sprinkler piping broken by roof collapse, reduced the pressure in the yard mains, and the gravity tank was quickly emptied. To stop water waste from the broken pipes, the fire department closed the sprinkler control valves.

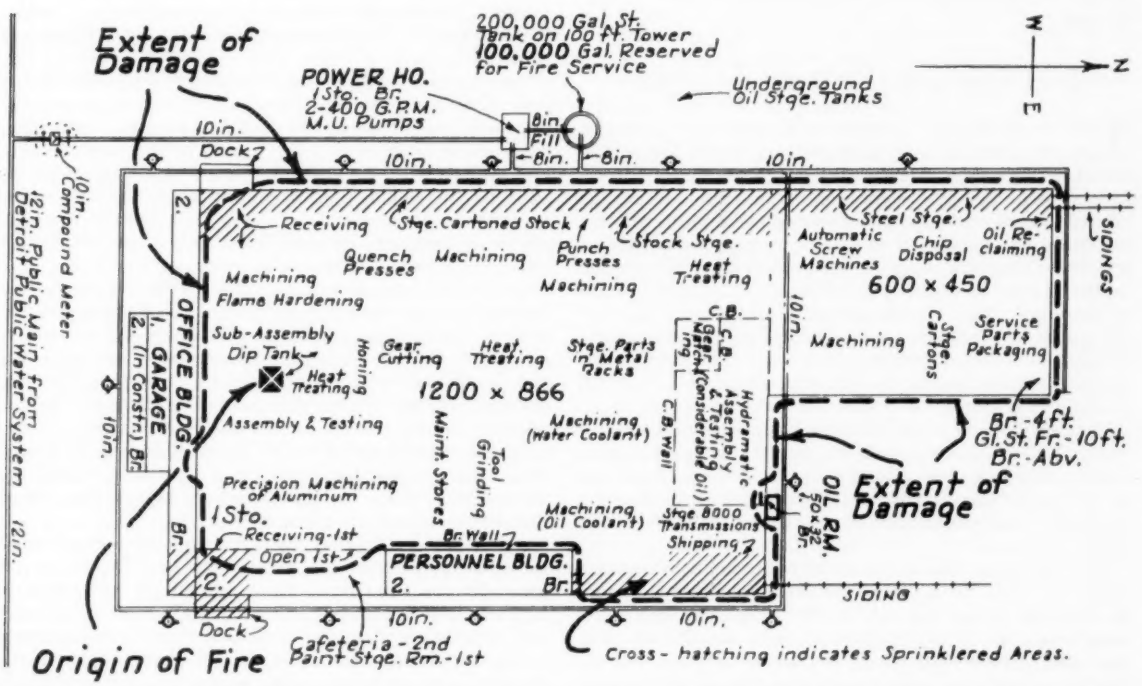


FIG. 6 PLAN OF WORKS SHOWS OCCUPANCIES AND WHERE FIRE STARTED; SPRINKLERED AREAS ARE SHOWN BY CROSSHATCHING

Even a stronger water supply and more hose streams would very likely not have been effective on a fire of this large area and intensity.

Roof collapse was progressive from south to north, and the entire roof caved in, followed by pulling in of the outer walls.

What furnished the fuel for the fire to spread? The presence of drip troughs, sizable exposed oil surfaces, and oily machine-shop occupancies could account readily for the spread of fire.

Heat apparently spread along the ceiling and melted the roof asphalt ahead of the fire. As the heat increased, the steel deck buckled, allowing air to reach the roof asphalt, which then ignited. Dripping and burning asphalt fell into the room where temperatures already were above the ignition point, and thus contributed additional fuel for the fire, but the large amounts of oil present without sprinkler protection alone could have wrecked the building structure.

There were no automatic sprinklers over some of the areas having flammable liquid. The CO_2 protection at the rust-proofing dip tank could not be expected to give adequate protection for the combination of dip tank and long, elevated drip trough. Neither could manual fire fighting be expected to be a dependable supplement. Automatic sprinkler protection is indispensable for such conditions.

CONCLUSIONS

Hazardous areas should be enclosed. This would prevent intense heat billowing along the ceiling, buckling exposed steelwork, and starting fires in other combustibles.

Welding and cutting operations, as one of the chief causes of serious fires, are the responsibility of a plant's fire organization and require close and continuous supervision at all times.

Manual fire fighting cannot be depended upon as a substitute for automatic sprinklers in buildings of this tremendous size. It is manifestly impossible to control a severe fire with hose streams alone if a building is very wide and cannot be entered. A narrower building would have permitted more effective fire fighting.

60,000-Kw Power Reactor

THE Atomic Energy Commission has embarked on a program to construct a full-scale power reactor. This was revealed by Thomas E. Murray, Fellow ASME, commissioner, U. S. Atomic Energy Commission, in an address before the Electric Companies Public Information Program, Chicago, Ill., recently. The reactor, he said, will produce a minimum of 60,000 kw of electric energy, with good possibilities of much higher output. It is proposed to have it in operation in three to four years. This, Mr. Murray added, is America's answer—its significant peacetime answer—to recent Soviet atomic weapons tests. It should show the world that, even in this gravest phase of arming for defense, America's eyes are still on the peaceful future.

The design of the reactor chosen was inherited from a Naval project. He pointed out, however, that it was not selected at random but was one of several studied for some time and approved by the entire reactor fraternity—and in addition, that this particular reactor was much farther along than any of the alternate systems.

Also, there are still a number of competent scientists and engineers, he said, who believe the AEC should have continued development efforts and only build a large-scale unit when more nearly sure that the power produced would compete in cost with conventional power. However, he said that the AEC recognized that such a course meant more paper studies and more delays and decided, therefore, to "launch out" into the reactor depths to construct a power-producing unit designed according to the technology known now or within reasonable reach of the engineer's grasp. The Commission was persuaded that it had much to learn that could only be learned by building and by operating. The AEC also recognizes that costs of power, derived from this first reactor, will be higher than costs from modern plants, he said. But the real answer to costs will never be known until several large-scale reactors are built and operated.

Consideration has been given to the possible location of this first reactor at or near one of the gaseous diffusion plants. If this is done, the unit would supply but a small fraction of the mammoth power requirements for such a plant. Any higher power costs would have small effect on the Commission's over-all electrical operating expense.

Because of previous experience with the reactor system chosen, Westinghouse Electric Corporation has been selected by the Commission as principal contractor for the development of this first power reactor. Private enterprise and private capital are invited to participate, Mr. Murray stated. The Commission will welcome offers from industry to invest risk capital in the building of the steam and turbine portions, as well as in the operation of the entire plant, he said.

Supervision of the project has been delegated to the AEC's Reactor Development Division. The director of this division, Dr. Lawrence R. Hafstad, has assigned the immediate responsibility for the job to Rear Admiral H. G. Rickover, the Navy reactor expert.

Future Power Supplies

THE future supply of power involves problems that require forethought and serious consideration, A. G. Christie, research professor of mechanical engineering, The Johns Hopkins University, Baltimore, Md., told a meeting of the Engineering Institute of Canada held in Montreal, Quebec, Canada. Professor Christie is a past-president and Honorary Member of ASME.

Studies of the growth of power systems, he said, indicate that peak loads have increased over long periods at an average cumulative rate between 6 and 7 per cent per year. Thus, peak loads double in about 11 years. There is little evidence that load saturation is near at hand. New uses for electricity are constantly developing on the farm, in homes, in factories, for electrochemical processes, etc. These will probably maintain the present rates of load growth for many years provided no wars or economic disturbances intervene.

This rate of increase until 1975 will lead to peak loads that are four times present demands, Professor Christie pointed out. The seriousness of the problem of future supplies becomes apparent from the need for construction of power-generating plants and distribution facilities by 1975 with capacities four times the total capacity of all present generating stations. One has only to consider the present generating capacity in electric control stations of approximately 80,000,000 kw in the United States and of about 9,910,000 kw in Canada to realize the tremendous increases in generating plants and distribution systems that must be in operation by 1975.

Approximately 7 million kw of new capacity were added to the power systems of the United States in 1952 at a cost of $3,700,000,000. In Canada about 840,000 kw were added in 1952 at a cost of $538,000,000. Plans called for the addition of 11,800,000 kw of capacity in the U. S. this year and additions of 665,000 kw were said to be contemplated in Canada. While 97 per cent of the homes in the United States are electrified, the average home use is only 2175 kwhr per year which is con-

siderably below the Canadian average. A factor in the increasing use in the home is the steady decrease in the average cost of service in spite of higher fuel and labor costs in production. In the U. S. this average cost decreased from 4.3 cents per kwhr in 1937 to 2.76 cents in 1952. Farm electrification is a load of increasing importance with an average use of 3075 kwhr in the U. S. last year.

The provision of increased capacity involves financial as well as engineering problems, Professor Christie declared. The average cost of new generating plants and distribution systems in the United States over the last three years was about $380 per kw of capacity. At this rate the cost of necessary additional capacity by 1975 in the U. S. would be about $91,200,000,000. If the same rate is assumed for Canadian steam and hydroelectric plants, totaling 46,667,000 kw, these additions will cost $17,733,000,000 by 1975. Professor Christie asked, where are these large sums of money to be found? How can such extensions be financed without causing economic disturbances? These money problems must be solved jointly by engineers and financiers, he said.

Some may question the high cost of future capacity. Low-cost hydroelectric sites near power-consuming centers already have been developed. The more distant sites will be expensive to exploit and will require costly transmission lines. The cost of steam stations has increased over 60 per cent during the last 20 years in spite of the use of large units and will probably continue to increase. Hence, the costs previously mentioned can be reasonably assumed for estimating purposes.

Engineers face difficult problems in the determination of the best and most economical means to provide for these increasing power demands, he added. Foresight is needed to estimate what sources of power may be made available, what location should be reserved for future power sites, and what distribution and interconnected systems should be planned. Steps should be taken at once, he warned, to secure sites needed for future generating plants before urban development or other commercial uses prevent the acquisition of the desired areas even though the property may not be used for some years. The art of power development is changing rapidly and all plans must provide for adjustment to such changes. It is evident that engineering statesmanship is needed to guide discussions on these developments.

1130-F Power Station

ACCORDING to Dr. H. Tietz, Farbenfabriken Bayer, Leverkusen-Bayerwerk, Germany, a steam boiler and back-pressure turbine working at 2280 psi and 1130 F at the outlet of the boiler have been in operation at that power plant since November, 1951. The entire August 21, 1953, issue of *Zeitschrift des Vereines Deutscher Ingenieure* was devoted to this installation.

The boiler, a Benson type designed for outdoor use, was supplied by the Dürr Works, Dusseldorf-Ratingen, and has a capacity of 276,000 lb per hr. It is fitted with a melting hopper for molten slag removal. Fly ash, which is separated by a Feifel cyclone plant, is returned to the combustion chamber. The steam first passes through a back-pressure turbine which works in a pressure drop of 2280 psi and 1130 F to the back pressure of 440 psi. Part of this steam at 440 psi is used for driving the feed pump and for regenerative preheating, the remainder flows through a subsequent radial turbine of the Ljungström type and expands to a pressure of 100 psi. The steam is then condensed in a heat exchanger. By means of its heat of condensation it produces vapor at 85 psi from chemically softened water which is used for manufacturing purposes.

The feed pumps deliver the condensate of the heat exchanger at a temperature of 330 F and force it up to a pressure of 3420 psi. The feedwater is brought to approximately 400 F by means of condensing steam at 440 psi and enters the economizer of the boiler at this temperature.

The difficulty in the construction of this plant was the selection of the best fit material. The tubes in the economizer of this boiler consist of carbon steel containing about 0.20 per cent C. The tubes of the heating surfaces of the evaporator are made from 0.5 per cent molybdenum steel, the superheater tubes for steam temperatures up to 932 F being manufactured from 0.8 per cent chrome and 0.4 per cent molybdenum. A high-alloy chrome-nickel steel was chosen for the remainder of the superheater in which the steam is heated up to 1130 F, that is, in which the material of the tube walls is subjected to a temperature of up to 1200 F.

In American plants, which are in operation at a temperature of 1050 F, an austenitic material containing 18 per cent Cr and 8 per cent Ni for the last part of the superheater is used. As a result of discussions with American engineers, namely, J. J. Kanter, Crane Company, Chicago, Ill., and Richard F. Miller and D. C. Buck, of United States Steel Corporation, Pittsburgh, Pa., the original intention of using 16 Cr-13 Ni-3 Mo steel was abandoned and instead of that a 16 Cr-13 Ni steel without Mo but stabilized with columbium was selected. Not only are the tubes of the superheater manufactured of this material but also the pipes connecting boiler and turbine, valves and slide valves, collectors, and other parts subjected to high temperatures.

In order to minimize temperature shocks, the connection between boiler and turbine is not constructed as a single pipe but is arranged in the form of a cluster of 28 tubes made from the same austenitic steel. Each of these tubes has an interior diameter of approximately 1.5 in. and a thickness of 0.5 in.

The turbine is of the single radial type and was supplied by the Siemens-Schuckert Works. It has a casing made from ferritic material. Apart from the fittings, the intercept valves, and control valves in the turbine, only the nozzle casings and the first stages up to a steam temperature of approximately 970 F are constructed from austenitic materials. All the remaining parts are of ferritic materials. Chrome-molybdenum steels have been used in cases where temperatures render this necessary. Up to the present time the boiler of this plant has experienced 11,000 running hours on full load, the turbine about 7000. Thus far the materials selected have proved to be satisfactory. In the case of valves or collectors of great wall thickness made from austenitic material where large differences in temperature during heating or cooling have occurred inadvertently, cracks have appeared as a result of temperature shock. It was possible to overcome slight damage, which occurred in the 1000-F temperature range in ferritic material of the shaft labyrinth packings of the turbine, by altering the construction and changing over from 6 per cent chrome steel to 13 per cent chrome-molybdenum-vanadium steel.

Flanged joints have been avoided in so far as possible. All fittings are welded. Welding of the tubes was carried out partly by the Heliarc process, although in the main the electric-arc process was employed using pure austenitic electrodes. Joints between austenitic and ferritic materials were made by means of mechanical flanges. It was found that the material, particularly the austenitic material, is sound and, moreover, is still tough after the period it has been in service.

In spite of the high steam temperature the austenitic materials show remarkably little tendency to oxidation, especially if there is no salt present in the feedwater. For this reason efforts are made to keep the salt content in the feedwater lower than 0.15 ppm. After thermal degasification some hydrazine hydrate is added to the feedwater (approximately 0.5 ppm),

to make absolutely certain that there is no more oxygen in the water, and it is kept alkaline by addition of ammonium hydroxide (approximately 0.2 ppm).

During the whole period in which it has been in operation, the plant has proved to be reliable. Should it be decided to enlarge the power station, the same temperature would be used, provided the investigations which have been made do not open up the possibility of a further increase in temperature.

Load-Calibrating Devices

THE development of load-calibrating devices of unusual size and capacity by the National Bureau of Standards, Washington, D. C., will permit the standardization of the largest materials-testing machines in existence. The four NBS 3 million-lb-capacity compression dynamometers, recently completed, are said to measure accurately forces up to 12 million lb.

MULTIMILLION-LB TESTING MACHINES

Prior to development of these dynamometers, which use attached wire-resistance strain gages as part of their load-indicating systems, the highest load which could be measured accurately was approximately $2^1/_2$ million lb. To do this required the simultaneous use of a considerable number of calibration devices (such as proving rings) of 200,000 and 300,000 lb capacity. It is estimated that a testing machine now can be calibrated to 10 million lb by means of the new dynamometers in about $^1/_4$ the time and about $^1/_2$ the cost formerly required to calibrate it to $2^1/_2$ million lb.

NBS for many years has maintained a program to provide means of verifying the accuracy of tension and compression-testing machines. These machines, widely used by industrial plants and laboratories, vary in size from small devices for testing small samples of rubber, textiles, plastics, and similar materials, up to the huge machines capable of crushing a steel girder or a concrete cylinder several feet in diameter. Typical examples of these machines are the 4 million-lb machine at the University of California, Berkeley, Calif., and the 5 million-lb machines operated by the Department of the Navy in Philadelphia, Pa., and the Bureau of Reclamation at Denver, Colo.

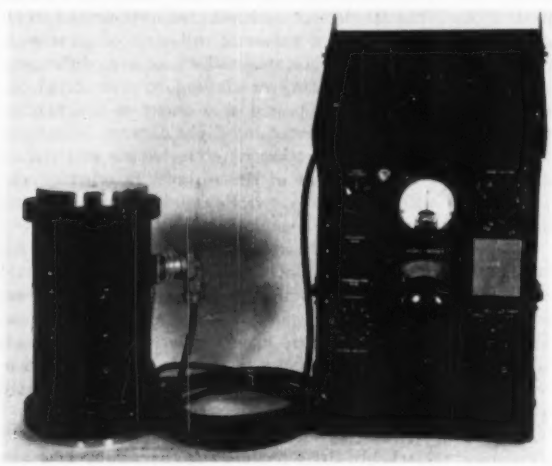


FIG. 7 THE 1 MILLION-LB DYNAMOMETER AND ITS ELECTRICAL INDICATING INSTRUMENT

(With this and other higher-capacity devices, such machines can now be calibrated up to 12 million lb.)

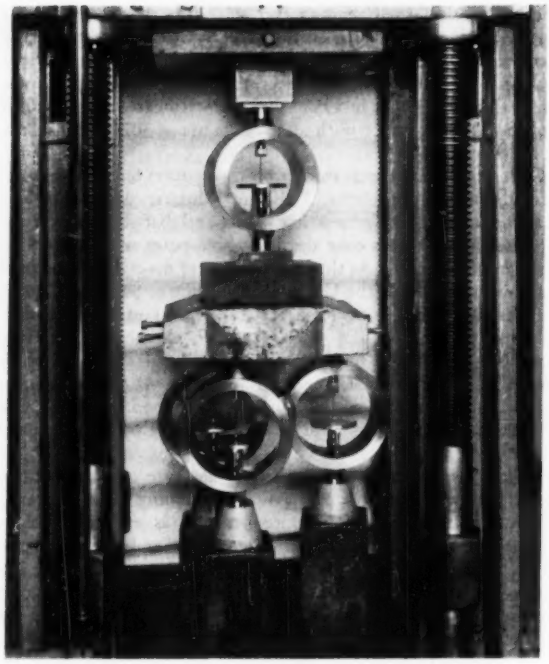


FIG. 8 A 300,000-LB-CAPACITY PROVING RING BEING CALIBRATED BY LOADING IT AGAINST THREE 100,000-LB RINGS

NBS long has had a machine with a capacity of 10 million lb, believed to be the largest capacity of any testing machine in the world.

High-capacity testing machines are both important and necessary to an engineering-research program, as tests of small specimens do not always give a complete picture of what may be expected from a structure fabricated from large rolled sections or forgings. It has been the experience of research engineers that the soundest approach to the solution of this problem is to apply actual service loads to full-scale specimens which have been fabricated from the same type of materials used in the real structure. This means that in the case of such structures as welded ship hulls and aircraft fuselage and wing components, the loads required will be great.

Still another reason for emphasis on testing full-scale units is the fact that failure of such structures in service is sometimes due not to lack of strength of the material but rather to points of high stress. These critical areas are caused by designs which include sharp angles or notches introduced into the structure during machining or welding. Points of high stress may operate in various ways; a complicated shape welded together may shrink as it cools, in such a way that parts of the structure are stressed almost to failure before any external load is applied; or a notch cut in an airplane-wing hinge may concentrate stresses 2 or 3 times as great as the average computed stress. It is impossible to reproduce, in a small-scale model, the effects of welding stresses or machining notches.

CALIBRATION

In order that the results obtained in research of this type may be considered reliable enough to be compared with results from different laboratories, NBS must control the accuracy of its testing machines. It is a simple matter to calibrate smaller machines by use of proving rings, but the calibration of the larger machines presents definite obstacles. Proving rings are

made in capacities up to 300,000 lb, and although it is possible to calibrate above this limit by loading several rings simultaneously (the method has been employed up to about 2.6 million lb), the process is costly and difficult.

The objective of NBS was the design of devices that would achieve the stability and accuracy of the proving ring. The unique features of these NBS load-measuring devices are said to be the application of the method of using wire strain gages for measurement of very high loads, the procedure used to calibrate the devices, and the particular feature of design in which the highly stressed column is flared out at top and bottom to integral ends having bearing surfaces of relatively large area. This design results in relatively low stresses between the device and the bearing blocks through which they are loaded by the testing machine, so that accurate and reproducible results may be obtained.

The dynamometers are employed in conjunction with an electrical indicating instrument, modified from the ordinary commercial strain indicator for strain gages. The electrical instrument is used to measure the small shift of balance of a bridge circuit composed of elements of wire-resistance strain gages attached to a highly stressed portion of the device. By mounting some of the gages in such a way as to measure the compressive strains parallel to the load axis of a compressive column, and other gages to measure tension strains caused by the lateral expansion of the same column, a bridge having a maximum output and good temperature compensation can be formed.

The NBS devices are calibrated by extending the method developed for large proving rings which exceed the capacity of the Bureau's 110,000-lb dead-weight-testing machine. In calibrating a 300,000-lb ring, the ring is first calibrated as far as possible by dead weights. It is then set up in a testing machine and loaded against three 100,000-lb proving rings, which have been calibrated previously to capacity by dead weights. The load exerted by the machine is transmitted through the 300,000-lb ring and shared equally by the three 100,000-lb rings. All 4 rings are read at once and the load is computed from the readings of the 3 smaller rings. In this way a calibration may be secured to 300,000 lb and the errors of the testing machine do not affect the result.

In extending the process, 4 large rings are calibrated by this method and then used together to calibrate a million-lb wire strain-gage dynamometer; 3 or 4 of these, in turn are used to calibrate the 3 million-lb device.

Although there are many problems yet to be solved in this type of instrumentation, the present devices appear to be satisfactory in the work done to date. On the basis of widespread interest among materials engineers, NBS predicts that dynamometers of this new type will be used to calibrate large testing machines in government laboratories, universities, and other research laboratories, at a reduced cost and a saving of time.

Giant Oil Hydraulic Pumps

A PAIR of oil hydraulic pumps, each having a maximum capacity of 4000 hp, were demonstrated recently by Waterbury Tool, Division of Vickers, Inc., Waterbury, Conn.

Designed and constructed by Waterbury Tool, the pumps, size 300, heavy-duty, are high-pressure, oil hydraulic pumps of the axial-piston, variable-displacement, reversible angle-plate type. Each pump weighs over 20 tons and is said to be the largest of its type ever designed and manufactured.

These pumps were designed for the E. W. Bliss Company of Canton, Ohio, for use on a giant tube-reducing machine which E. W. Bliss is building for Tube Reducing Corporation in Wallington, N. J. (See MECHANICAL ENGINEERING, November, 1953, page 904.)

When completed, the giant machine will produce cold-finished tubing compression-formed to size, shape, and finish. It will process ingoing tubes ranging in outer diameters from 18 to 10 in. for reductions from 17 to 9 in. in outer diameters.

In the tube-reducing machine, these pumps are required to move the 150-ton saddle which carries the dies back and forth across the tube at a closely controlled rate and through a closely controlled distance. The maximum length of the saddle reciprocation is 72 in. The maximum rate of reciprocation is one

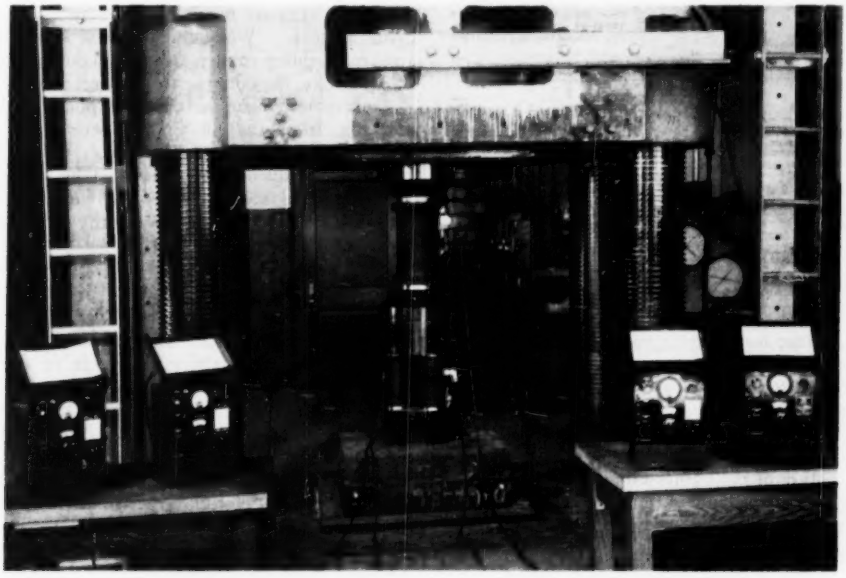


FIG. 9 SETUP IN THE NBS 10 MILLION-LB TESTING MACHINE SHOWING THE CALIBRATION PROCEDURE FOR A 3 MILLION-LB DYNAMOMETER

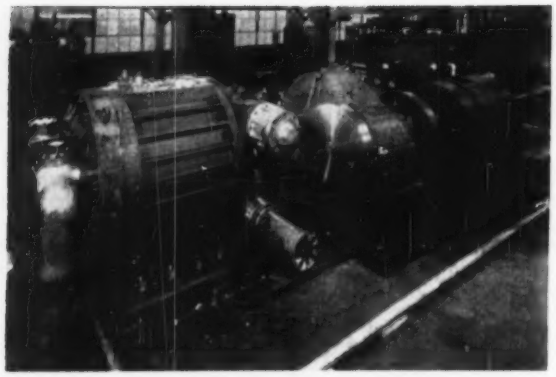


FIG. 10 GENERAL VIEW OF ONE OF THE GIANT HIGH-PRESSURE OIL HYDRAULIC PUMPS

FIG. 11 SHOWN LEFT TO RIGHT ARE THE CASE-HEAD TILTING BOX, TILTING BOX, CASE, AND VALVE PLATE FOR THE NEW OIL HYDRAULIC PUMP

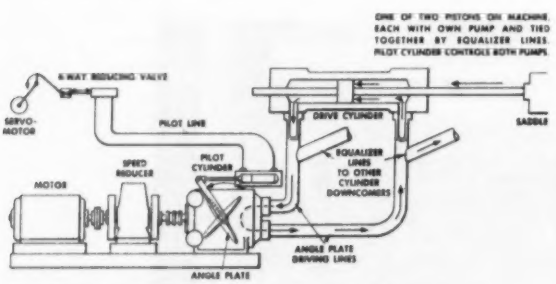

ONE OF TWO PISTONS ON MACHINE, EACH WITH OWN PUMP AND TIED TOGETHER BY EQUALIZER LINES. PILOT CYLINDER CONTROLS BOTH PUMPS.
4 WAY REDUCING VALVE
SERVO-MOTOR
PILOT LINE
DRIVE CYLINDER
SADDLE
SPEED REDUCER
PILOT CYLINDER
EQUALIZER LINES TO OTHER CYLINDER DOWNCOMERS
MOTOR
ANGLE PLATE DRIVING LINES
ANGLE PLATE

FIG. 12 DRIVE SYSTEM OF 18-IN. TUBE REDUCER

cycle per second. Since no reversing valves are used, this requires that the pump reverse its delivery once each second. A specially designed cycling control is used for controlling the pump delivery on the machine.

DESIGN

The reversing feature of the pumps eliminates the necessity for separate reversing valves on this application.

Adjustable displacement of the pumps permits speed control of the saddle in either direction without separate flow-control valves.

Centering cylinders are built in on each pump. They are spring-actuated and pressure-released. They are so arranged that in the event of electrical or pressure failure, they will immediately center the pumps, stopping the saddle. They also insure that the pumps are in neutral when starting.

Each of the two pumps per machine is capable of delivering up to 2300 gpm in either direction of flow at pressures up to 3000 psi and will operate either as a pump or a hydraulic motor.

The pumps operate the saddle cylinders in a closed circuit supercharged from an external pressure source and the replenishing check valves are built integral with the pump.

Each pump has 13 cylinders using pistons approximately 4 in. in diam.

Overload protection is provided by full-flow by-pass relief valves—one for each line—which are also integral with the pump. These relief valves are adjustable.

System connections are 10-in. ips for the main system and 3-in. ips for circulation and replenishing, in order to keep friction-line losses to a minimum.

A sliding-type control on each pump determines the direction and rate of oil flow (the sliding control is actuated by an external hydraulic cylinder operated by the master cycle control). Stroke length and rate are adjustable while running and on this application will provide any speed from zero to 45 cpm.

Because each pump in this application is required to stroke from zero to 2300 gpm in one-half second, then back to zero in one-half second and reverse through the same cycle, it is important to keep the reversing load to a minimum. For this reason, the angle plate in the pumps is mounted on a vertical axis to eliminate gravity effects on rapid stroking.

The main thrust and radial bearings for this pump had to be specially designed.

The weight of a complete pump is in excess of 20 tons.

OPERATION

In use, each pump is connected across a double-acting cylinder with equalizing lines between the cylinders to insure simultaneous operation. The stroking of the saddle approaches a sine-wave motion with the pump moving from zero to full stroke during the first half of the saddle movement in one direction and then moving from full stroke to zero in the second half, during which the pump runs as a motor and acts as a brake. The pump angle plate crosses neutral just before the end of the saddle cylinder stroke. When the saddle is at the mid-point of its stroke, the pump angle plate gives maximum flow. At the end of the stroke, the pump angle plate gives minimum flow.

A servomechanism controls the pump angle plates during stroking, using the phase shaft between the saddle and the pumps to provide the control force. The stroke length and the stroke frequency are controlled by the same mechanism governing the rate and the angle through which the pump angle plates are moved relative to the saddle motion.

New Photographic System

A MULTIEXPOSURE, microsecond photographic system that records activity at speeds of one-millionth of a second and even smaller speeds under certain conditions, has been developed by electronics engineers at the Midwest Research Institute, Kansas City, Mo. The scientists, Leon D. Findley, J. H. Van Horn, and Elbert S. Kennedy, of the Institute staff presented a technical paper describing the system before the ninth annual National Electronics Conference in Chicago, Ill.

The new photographic device is expected to be extremely valuable in tasks of scientific investigation since it is often necessary to photograph objects or phenomena which change rapidly in position or characteristics. Use of the new photo-

graphic system will enable scientists to obtain sequence pictures in good detail of such actions as projectiles in flight, blast studies, and other developments requiring minute examination.

Integral units of the new device are a timing-pulse source and driver, an energy storage and power supply, and a photographic recording instrument. The latter mechanism can be either a high-speed movie camera operating at 7000 frames a second (more than 500 times as fast as a normal movie-camera speed) or a high-velocity drum-type camera.

This photographic system which operates on electronic principles has been conducted satisfactorily at Midwest Institute.

Automotive Batteries

CURRENT heavy-research emphasis in the automotive-battery field is on durability and extending the period of usefulness, according to the October, 1953, *Industrial Bulletin* of Arthur D. Little, Inc. Competition has driven prices down to where the major cost is that of raw materials,chiefly lead; and sales emphasis is on quality, which generally shows up in longer life.

STORAGE BATTERIES

Storage batteries are used in most engine-driven vehicles, as well as in power stations, telephone exchanges, burglar alarms, rural lighting systems, marine buoys, radio-broadcasting stations, and in applications where a loss of generated power would create a serious problem. They serve either as standby sources of power which can be regenerated, or as compact sources of high currents.

Commercially, storage batteries first were used in stationary service, as in lighting plants, but since about 1900 the portable battery for motor vehicles has been used increasingly. Mass production of cars, plus severe competition in the battery business, caused battery manufacturers to develop mass-production methods of their own. In the early 1920's, almost every part of the battery was handmade; now the only hand operations are in final assembly, and this is becoming mechanized in some plants. The results have appeared in price reductions from the $50 to $70 range to the present $10 to $25. Better engineering has also produced more compact units and greater dependability in varying climates.

LEAD-ACID BATTERY

The ordinary lead-acid automotive-battery cell consists of two sets of lead grids, one negative and the other positive, each set covered with a different chemically active paste. These active materials, in a fully charged battery, consist mainly of lead peroxide on the positive plate and spongy lead on the negative. On discharge, part of the lead peroxide and the spongy lead are converted to a form of lead sulphate by reaction with the sulphuric-acid electrolyte; charging restores the original compounds. The plates are separated physically from one another by an insulating material. The electric circuit is formed by an external connection and the electrolyte filling the space between the plates.

A leading cause of automotive-battery failure is corrosion of the positive grid through overcharging. Automobile systems normally keep the battery slightly overcharged, so battery manufacturers must produce a battery with resistance to overcharge corrosion. Batteries with new lead alloys in the grid elements have been on the market for about three years. While it is too early to judge what the actual service records will be, tests during the development period indicated 50 to 100 per cent additional battery life.

Improved separators to insulate positive from negative plates have led to more compact batteries, and have reduced the danger of internal short circuits. Microporous rubber, glass fiber bonded to wood, and resin-impregnated porous materials are now replacing wooden separators. By improvement of the chemically active paste which is the source of electric current, it is now possible to use less paste and to develop more cranking power for the automobile.

Several manufacturers now make batteries that are manufactured, shipped, stored, and sold without any electrolyte. The dealer, when selling the battery, fills it with acid and delivers the fresh, charged battery to the customer. This feature prevents any loss of life expectancy because of undesirable chemical reactions during lengthy storage.

OTHER TYPES

While lead-acid batteries are the most common type in this country, two other types are used in special services—the nickel-iron and nickel-cadmium cells. Both use an alkaline electrolyte, which is noncorrosive to many common metals. The nickel-iron cell is used widely for traction service, especially for industrial trucks, lifts, and other vechicles for materials handling, and for railroad equipment, since it has high electrical capacity for a small volume and weight and does not readily lose this capacity over many cycles of charging and discharging.

The nickel-cadmium cell long has been used in Europe for automotive starting, power stations, and communications. Recently it has been introduced here, although not for automobile use. Several American companies are now manufacturing nickel-cadmium batteries with a special sintered-plate construction to reduce the size and weight. This type of battery is finding uses in emergency lighting, switchgear operation, and industrial equipment. For such service, life expectancy might be 15 to 20 years, compared with a common expectancy of five to ten years (or in some cases up to 20 years) for a lead cell. The nickel-cadmium battery also is used in aircraft, where a battery life equal to that of the plane might be expected.

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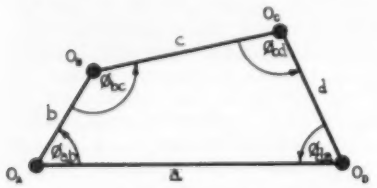
ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Machine Design

An Analytical Approach to the Design of Quadric Chain Mechanisms, by Ferdinand Freudenstein, Jun. ASME, Columbia University, New York, N. Y. 1953 ASME Fall Meeting paper No. **53—F-10** (mimeographed; to be published in Trans. ASME).

THE symmetry inherent in quadric chain mechanisms is used by the author to derive a general analytical expression relating the diagonals of a 4-bar linkage by means of a characteristic parameter. The nature of this expression is analyzed. The particular case obtained by using as a parameter the square root of the sum of the squares of the lengths of the links, diminished by the sum of the squares of the diagonals, is worked out in detail and the results are reduced to a form believed to be useful in design work. Design applications are also considered.



4-BAR LINKAGE

Having the minimum number of links required for determinate motion, the 4-bar linkage may be regarded as a fundamental mechanism—as a basic building block in terms of which other mechanisms can be analyzed. The 4-bar linkage is used in all types of machinery, ranging from locomotive drives to delicate computing instruments. Its universality is the result of several factors: (1) Simplicity of conception and of manufacture, (2) flexibility in design as a means of power and motion transmission, (3) adaptability to efficient operation at high speeds, and (4) high efficiency as a result of design for minimum backlash and friction. The versatility of the 4-bar linkage has led to the development of a variety of design techniques. Since the introduction of the basic concepts of Reulcaux, much work has been done on coupler curves, on the development of general design methods involving techniques in projective geometry, and on the adaptation of a theory of polynomials and other advanced methods to synthesis problems.

The author states that advances made in this country during the past decade indicate the increasing importance of kinematical problems in which systematic methods are a prerequisite. There have been published: A mathematical analysis of 4-bar linkages; graphical methods for the design of computing linkages; and a method of using the diagonal to facilitate linkage computations. In these investigations, emphasis has been placed on immediate applicability to design rather than on basic analyses, although the need for the latter is realized. In his paper, the author uses basic geometry in an attempt to develop an analysis, the results of which may be sufficiently simple and direct to be of value in design.

Minimization of Gear-Train Inertia, by Edward G. Burgess, Jr., Jun. ASME, Ford Instrument Company, Division of The Sperry Corporation, Long Island City, N. Y. 1953 ASME Fall Meeting paper No. **53—F-13** (mimeographed; to be published in Trans. ASME).

IN the design of a system consisting of a motor driving an inertial load through gearing it is often necessary that the acceleration of the load be a maximum; the gear ratios giving a maximum acceleration are determined in this paper either for a specified over-all train ratio, or for the condition where the over-all ratio must be found.

Charts, which embody certain simplifying assumptions, are provided for selecting the optimum number of gear ratios and the ratios of the individual meshes corresponding to maximum load acceleration. This paper describes by use of equations, graphs, and diagrams, several mesh systems; equations are obtained for single-mesh, two-mesh, and *n*-mesh gear trains.

The author is concerned with the utilization of the available motor torque to greatest advantage in accelerating a load in order to make the torque-inertia ratio at the load shaft a maximum.

The formulas and charts developed have specific application to the design of high-quality servomechanisms where the response consists of a motor driving

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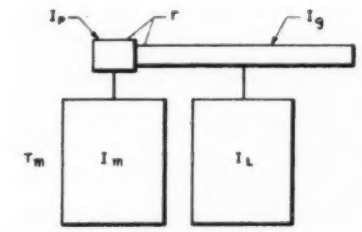
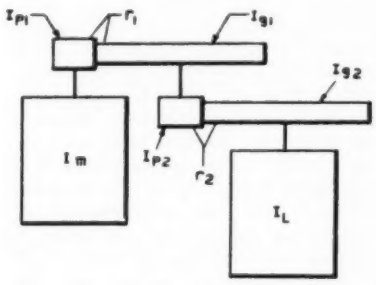


SINGLE-MESH SYSTEM



TWO-MESH SYSTEM

various inertial loads by means of gearing. (In order to clarify the principles involved, friction and external load torques are not considered.) The principles developed are also applicable to hydraulically driven linear-displacement mechanisms where the connections to the inertial load are made through linkages. Many analogous systems may be treated in a similar manner.

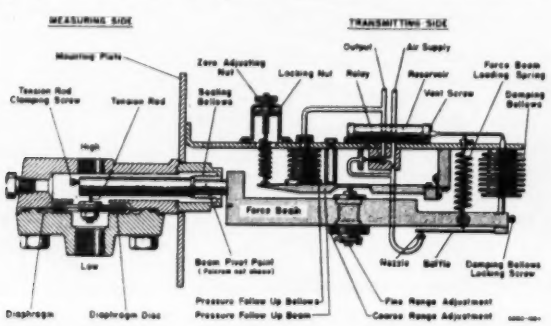
Some Problems in the Design of a Differential Pressure Transmitter, by J. R. Davidson, Mem. ASME, Taylor Instrument Company, Rochester, N. Y. 1953 ASME Fall Meeting paper No. 53—F-12 (mimeographed).

THIS paper is concerned with the design of an instrument to convert a small differential between two high pressures into a pneumatic signal. The basic problem is reviewed and some specific design problems are dealt with in detail. The project is discussed as a problem in product design rather than one of instrumentation.

A particularly difficult industrial measurement problem is that of measuring small differential pressures at high static pressure levels. This paper discusses the design of a transmitter, or converter, which was designed to detect pressure differences as small as 20 in. of water at static pressures up to 1500 psi, and to convert this difference into a standardized pneumatic signal varying from 3 psi to 15 psi. This signal is used with standard pneumatic instruments for recording or controlling.

Early in the development it was decided that this instrument would be designed to operate on the force-balance principle, whereby a pneumatic system operates to produce a balancing force equal and opposite to the force produced by the measuring element and thereby allows very little motion of the measuring element. This system was chosen because it operates with a minimum displacement and consequently minimum movement of fluid in and out of the measuring chamber. This is a great advantage in many measurement problems. Further, the absence of large motion of the measuring element results in the improved performance by reducing hysteresis effects in the measuring element and nonlinearities due to changes of effective area which occur with motion.

Referring to the accompanying diagram, the two pressures to be compared are introduced into the chamber at the left, the higher one above. An increasing differential, acting on the diaphragm produces a downward motion at the left end of the beam. This beam allows more air to escape from the nozzle, lowering the pressure in the nozzle line and in the diaphragm chamber of the air relay. The resulting motion of the relay valve ball to the left closes off the vent port, opens the supply port, and increases the output pressure. This output pressure is fed into the follow-up bellows. The force of this bellows is exerted downward through the intermediate lever and range adjustment pin to counterbalance the upward force which the differential acting on the diaphragm had produced, thereby restoring the beam to its balanced position. The output pressure will be almost exactly proportional to the input differential, and the proportionality factor can easily be changed over wide limits by moving the range adjustment to change the lever ratios.



CUTAWAY VIEW OF INSTRUMENT

Manufacture and Application of Toothed Face Couplings and Clutches, by Ernest Wildhaber, Fellow ASME, Rochester, N. Y. 1953 ASME Fall Meeting paper No. 53—F-14 (mimeographed).

THIS paper describes a new machine, built especially for cutting toothed face couplings and clutches and intended for quantity production, often making one operation possible where two were needed previously. Some of these techniques are described. An improvement in finishing fixed couplings from the solid is discussed.

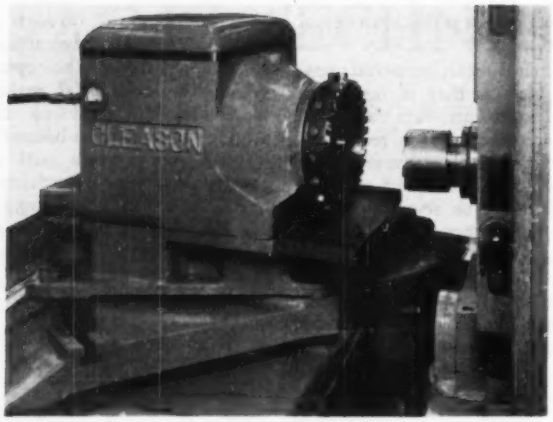
It is shown how saw-tooth clutches can be cut in one operation with a disk-type milling cutter of standard diameter, whereby the helical sides are generated with side-cutting edges rather than with a small edge radius.

The most radical departure from prior practice lies in cutting shift clutches with double helical chamfer surfaces forming roof-shaped tops on the teeth. Both the chamfer and the sides are produced in a single operation with a face-mill type cutter. The helical chamfer surfaces of opposite hand are simultaneously generated without rotation about the work axis. This is an entirely new process disclosed in this paper for the first time.

The Gleason Works, Rochester, N. Y., has built a new machine adapted primarily to cutting toothed face couplings and face clutches rather than gears. The purpose is to realize manufacturing advantages not possible with the gear-cutting machines previously used also for such couplings. New techniques are feasible and are being developed.

The machine mounts a rotary cutter of either face-mill type or of disk type. The type of cutter depends on the form of teeth. The cutter axis is arranged in a horizontal plane. It can be set and fed about a vertical pivot axis which intersects the cutter axis, and the cutter can be adjusted bodily along its axis with respect to its pivot.

The work is adjustable horizontally and vertically and angularly about a vertical axis. It can be turned on its



VIEW OF CUTTER END OF MACHINE

axis at a uniform motion or at an intermittent motion, and in combinations of both.

Depthwise feed is provided on the cutter slide. It is controlled by a disk cam. Likewise the swinging feed of the cutter on its vertical pivot is controlled by a disk cam, which is mounted on the same spindle. Engagement between the disk cams and their followers is maintained by hydraulic pressure.

The use of simple disk cams permits making special cams on specific jobs with a minimum of expense. Special cams may be needed when two operations on the previous machines are changed over to a single operation on this machine.

An Illustration of Automatic Assembly, by C. E. Kraus, Mem. ASME, Kraus Design, Inc., Rochester, N. Y. 1953 ASME Fall Meeting paper No. **53—F-11** (mimeographed).

THIS paper contains a discussion of problems arising in the design of automatic assembly equipment for small workpieces received in bulk or stacked conditions. Various types of devices are illustrated as applied to a specific machine. Included are examples of a hopper or parts feeder, chuting, automatic insertion or positioning on a fixture, magazine feeding, auxiliary orienting, and automatic unloading or ejection. The machine discussed is a dual unit served by a single hopper and makes use of sequenced hydraulic circuits, electronic timing, and an electrically controlled interlocked air system. Each of the two units can operate independently.

The author notes that problems arising in the design and manufacture of automatic assembly equipment, for handling small and sometimes intricate pieces in bulk or stacked conditions, are probably as interesting and challenging as any found in the design of mechanisms. Each machine and each workpiece is different and usually only one machine is necessary to handle production requirements. Faced constantly with the need for something new to tax his ingenuity, the engineer-designer originates many new mechanisms.

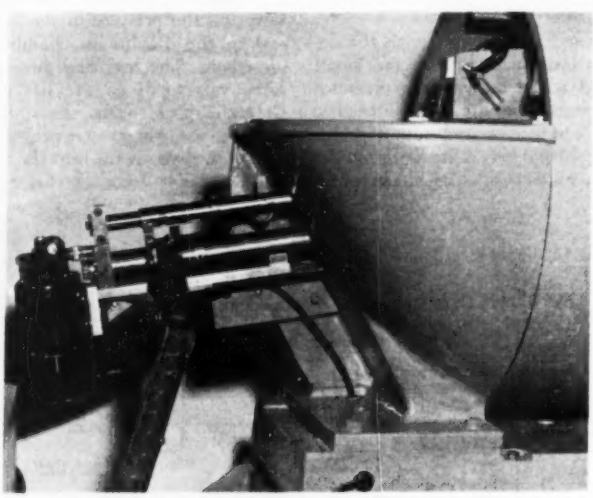
Machine Design and Problems—Before and After, by Howard H. Langdon, Mem. ASME, Curlator Corporation, East Rochester N. Y. 1953 ASME Fall Meeting paper No. **53—F-15** (mimeographed).

RESEARCH and development to diversify manufacture, business interests of a machine-tool manufacturing corporation, and the procedures followed in gaining effective contacts for ideas, patents, and projects are outlined in this paper.

The author emphasizes that machine-tool building is at its peak before and during any war effort of our nation. After the intense war requirements have subsided, conversion to peacetime tool requirements takes place and the manufacturing load tapers off. During the so-called normal times, there has been both "feast and famine."

Machine-tool building requires highly skilled labor. It is desired to hold a minimum turnover of employees in all phases of the factory group. These fundamental facts in the mind of management set in motion, just before the end of World War II, an intense effort to diversify both market approach and manufacture. Some of the more important aspects of the problems faced are given in this paper. Before discussing methods of approach and means for obtaining diversification, the requirements and limitations imposed by the nature of machine-tool manufacture and of the specific plant should be set forth. The particular group seeking diversification are builders of heavy machine tools with a minor division devoted to small units such as stud drivers, automatic taps and dies, quick-acting chucks, and milling cutters. This, naturally, means large buildings with high and heavy crane service, heavy machine tools, all of which result in comparatively large charges in addition to the cost of labor.

These factory conditions further dictate limitations and requirements in diversification more or less as follows: (1) The manufacture of relatively heavy machinery or equipment regardless of the industrial field in which diversification is sought, (2) machines that require the



VIEW OF SPECIAL TUMBLE-TYPE PARTS FEEDER DELIVERING PLASTIC PIECES TO EACH UNIT

use of an ample supply of highly skilled labor, (3) a separate division under top management for developing new fields of industrial enterprise and ultimately a division separate from the machine-tool group, (4) industrial innovations sufficient to provide a foundation for a new business, and (5) patentability or patent protection that permits at least five years of protection prior to the possible entry of competitive equipment.

The author notes that when it is remembered that the processes sought are new and represent innovations in the industry if proved successful, the designer has no precedent on which to base his work. The engineer-designer is moving into new areas and only his background of experience, plus sound judgment and ingenuity, permit him to proceed with any degree of success. He finds it necessary to seek assistance from all the groups concerned when he designs for production. He is no longer in position to dictate the form or construction of parts or the whole machine. At the same time he is held responsible for the functioning of the machine in service. Many times it is necessary to compromise with matters presented by responsible people in sales, purchasing, and manufacture, all of these matters requiring teamwork and co-operation of the highest order.

Production Engineering

Profits Through Effective Machine Replacement Programs, by Carl M. Beach, Cincinnati Milling and Grinding Machines, Inc., Cincinnati, Ohio, and Robert S. Collier, The Cincinnati Milling Machine Company, Wilmington, Ohio. 1953 ASME Fall Meeting paper No. **53—F-26** (mimeographed).

THIS paper, in affirming that the replacement of machine tools and productive equipment on the basis of rule-of-thumb or direct labor-saving methods is a serious hindrance to the country's productive capacity, presents the weaknesses of these methods and suggests a more effective means of helping management determine when equipment should be replaced.

The paper adds that today this country enjoys the world's highest standard of living, but under its competitive system it cannot afford to stand still. To answer the challenge for more and better products at lower costs in the years to come, management's answer will need to be more output per man-hour. To accomplish this will mean that capital investment for better plants, better production equipment, and better working conditions must be well planned. Constant improvement and progress is a basic requirement. To accomplish this, the principles of good management dictate that research and engineering efforts be directed to the development of the new, and that the merits of materials, methods, tools, and machines currently in use be subject to close scrutiny to determine what changes, improvements, and replacements are necessary, and highly important, when they should be made. This is a task which requires foresight and detailed analysis by top management—foresight because the decisions reached will affect the continued success and long-term survival of the company, and detailed analysis because all too often in the past, decisions on the replacement of equipment have been made by rule-of-thumb methods instead of by complete analysis based on sound business principles and economics.

For years the machine-tool and capital-goods manufacturers have been attempting to solve the problem. Various systems and formulas have been devised and, while steps in the right direction, the results have not been completely satisfactory. The problem was presented to the Machinery and Allied Products Institute, or MAPI, an association of the principal manufacturers of capital-goods equipment. As a result of rethinking the theory of replacement, MAPI published a full length book, "Dynamic Equipment Policy," which has become a major influence in bringing replacement analysis techniques up-to-date.

The MAPI formula takes into consideration all of the problems involved. Instead of projecting the future operating costs of the present machines or equipment, it projects their future operating inferiorities. By this is meant the amounts by which their operating performance will fall short of the performance of the best available new equipment on the market. Thus, the object of equipment replacement becomes simply a matter of securing the lowest obtainable capital cost and operating inferiority or imperfection. By reckoning this minimum combination in terms of the lowest annual average of the two machines or pieces of equipment, it can be said that the best one is the one that yields the lowest average.

According to the author, there are two principal requirements of a sound equipment policy: (1) A reliable technique for determining when equipment is economically replaceable and at the same time some measure of the cost of deferring replacement, and (2) an organizational setup to appraise management of re-equipment opportunities.

The author emphasizes in conclusion that no live industry can keep pace with the advance of technology without continuous renewal and transformation of productive facilities. The economic effects of the failure to re-equip are high costs, wasted manpower, low output, a lower standard of living, and, of great importance, social unrest.

The matter of re-equipment, and the methods and processes of manufacture in this country are still in the hands of top management. It is the one remaining thing that it can completely control. The consequences of bad mechanization are self-evident. The industrial strength of this nation is based upon the early replacement of its obsolete facilities, and today, as never before, it must be industrially strong.

Measurement of Superimposed Surface Finishes, by R. E. Carroll, Mem. ASME, and Norman Gortz, Micrometrical Manufacturing Company, Ann Arbor, Mich. 1953 ASME Fall Meeting paper No. **53—F-29** (mimeographed).

THIS paper is the result of an investigation of compound surfaces; that is, a surface which exhibits the characteristics of two different machining methods, one superimposed upon the other. A method is shown whereby one is able to measure and evaluate the resulting surface topography through the use of profile records. Surface-roughness profiles are shown indicating various surfaces after machining and again after honing and lapping has removed only a part of the original roughness. Important geometrical characteristics of machined surfaces such as feed marks, their depth and profile, and type of irregularities are considered. The profile records used have vertical magnifications up to 10,000×.

According to the author, the subject of surface finish is of great practical value since, in a great many applications, it has a distinct influence on the problem of wear and the load-carrying capacity of metals. In present-day industry, it has been found that the quality of the surface is often of the utmost importance for the correct functioning of the part. For moving surfaces, whether they be running or sliding fits, the finish obtained greatly affects friction and wear.

Since the dimensions of surface irregularities are too small to be measured by sight or touch, or by ordinary mechanical

instruments, new methods and instrumentation had to be developed, so that surfaces produced by machining operations could be measured and evaluated. As requirements, depending on the design and function of the parts being produced, differ considerably, many forms of instrumentation for evaluating surface roughness have been developed through the years in order to answer the demands of both the laboratory and shop.

In the constant effort to improve surfaces for certain applications, some manufacturers are currently superimposing a fine finish on a coarse pre-finish. The purpose of this paper therefore is first to describe instrumentation which may be used to analyze the geometry of these compound surfaces, and second, to show the results of a series of measurements of some superimposed finishes through the use of this instrumentation.

Barrel Finishing—Applications in Metal-Manufacturing Industry With Job-Shop Conditions, by John G. Reed, Brown and Sharpe Manufacturing Company, Providence, R. I. 1953 ASME Fall Meeting paper No. 53—F-27 (mimeographed).

THE removal of machining burrs, sharp edges, heat-treating scale, flash, and the blending elimination of surface tool marks are operations specifically covered in this paper. According to the author, these operations can be carried out efficiently and economically by the proper use of the barrel-finishing method, sometimes designated as "tumbling" or "rattling."

Barrel finishing is said to be a real time saver; complicated shapes, such as die castings, steel forgings, stampings, and machined parts, as well as the common simple part, can be processed with satisfactory results.

The equipment required for tumbling varies in type and design, each having its feature. The required equipment is dependent on the particular parts to be processed. Barrels are made in the triple-action, horizontal, octagonal with multiple compartment, portable bench, tilting-bottle type, and combination barrel and separator. The loading and unloading of the barrel is governed by the parts, its material, size, hard or soft, weight, finish required, and is done by hand or by loading a suitable separate container and with the use of a hoist, depositing work or abrasive in barrel. This separate container may be used also for unloading.

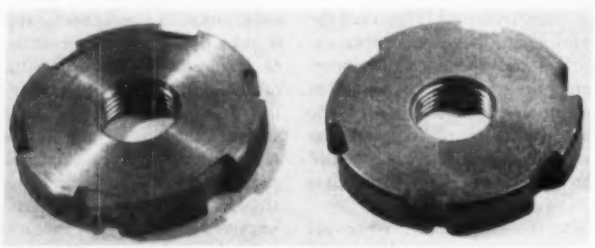
Abrasive materials used for barrel finishing are in miscellaneous grit numbers 00-T of an average particle size of $1^1/_2$ to 2 in. to the finer of "12T with an average particle size of standard No. 12 mesh" and finer; also used are sawdust, emery cloth, with the required amounts of water, cleaner, antirust, or coloring agent as required by work being processed.

The author states that the scope of parts that can be barrel finished for burring, removing sharp edges, and finishing is quite extensive in that ferrous materials as well as nonferrous may be successfully accomplished. Here again, as in the type of barrel and handling, the success is dependent on the material, size, weight, and finish required with the correct abrasive, selection of parts to be processed together, with water, compounds, and processing time.

The four factors to be considered when a job is processed by the barrel-finishing method are: (1) Size, shape, and weight of part, (2) kind of metal, (3) condition of burr, and (4) finish required.

When starting a production run on a barrel-finishing operation, the following factors have to be determined before proceeding with loading of barrel: (1) Selection of work, abrasive grain size; (2) time-cycle (length of tumbling time), type and amount of cleaner; (3) barrel speed; and (4) separation of work from abrasive.

The layout for a barrel-finishing department should be based on existing or anticipated conditions, but should consist of flooring to carry off liquids, bench for checking work before or after processing, cleaning and oiling tank, barrel finishers to suit, abrasive containers, screen or separator for abrasive sizes. With quantity production, an abrasive separator and weighing scales to determine the volume processed is recommended by the author.



SPECIMENS SHOWING EFFECT OF BARREL-FINISHING METHOD (*left*), BEFORE DEBURRING; (*right*), AFTER DEBURRING

Fuels

The Midwest Solid-Fuels Situation, by W. H. Voskuil, University of Illinois, Urbana, Ill. 1953 Joint ASME-AIME Fuels Conference paper No. 53—FU-2 (mimeographed).

SOLID fuels in the Middle West supply two distinct and now competitive markets—metallurgical fuel; and coal for general manufacturing, electric utilities, transportation, and retail use. Fuels for metallurgical use are obtained almost exclusively from the low-medium and high-volatile coal fields of West Virginia and Kentucky. Demand has increased consistently and prices of coal have risen to a greater degree than the price of coal for general use. In this latter market outlet, all except electric-utility coal have encountered a declining market. This is especially the case in the railroad-fuel market.

The Midwest obtains its coal supply from 16 coal-producing states extending from the Appalachian field in the east to the mountain states of Montana and Colorado.

The total quantity of coal shipped into this area by means of all rail and lake-cargo transportation approaches 100 million tons annually.

The effect of increasing natural gas and oil fuel showed oil competition as becoming evident in 1946.

About one sixth of the coal shipped into this area is used in the manufacture of metallurgical coke and in noncompetition with coal supplied by Illinois, Indiana, and West Kentucky mines. This particular coal market also is not affected by competition from oil and gas.

Natural-Gas Supply for Chicago and the Middle West, by K. B. Nagler, Peoples Gas Light & Coke Company, Chicago, Ill. 1953 Joint ASME-AIME Fuels Conference paper No. 53—FU-1 (mimeographed).

HIGH LIGHTS of the history of gas business in Chicago from gaslight to gas-heat period, with references to manufactured gases, an early natural-gas interlude, and the present mixed manufactured-natural gas are presented. The significance of terminal storage of natural gas, the expansion of pipe-line systems, and the growth in natural-gas reserves are outlined.

In the early days, Chicago had two gas companies, the first introducing gas to the public Sept. 4, 1850, and the second beginning operations in 1862. Between 1871 and 1895, eleven other gas companies were incorporated to do business in Chicago or in one of the suburbs which became part of Chicago. Nearly all of these companies made gas by the carbureted water-gas process since it produced the brightest light and was flexible. The various competing gas companies were finally consolidated with The Peoples Gas Light and Coke Company, beginning in 1897. The smaller, less economic plants were shut down and ultimately dismantled, and the company entered upon an era of vigorous expansion. The main element of this expansion was the large-scale introduction of domestic gas stoves, over 20,000 having been sold by Peoples Company alone in 1898. As previously noted, the gas arc lamp also added substantially to the gas load. Twenty years later there were over 500,000 gas ranges in service in Chicago. In 1915 the domestic cooking load accounted for 75 per cent of annual sales, with a load factor of about 74 per cent as compared with the lighting load factor of 49 per cent.

From 1919 to 1931 there was a 530 Btu period in Chicago. The base gas supply which had been carbureted water gas became coke-oven gas as a result of the purchase of increased volumes of surplus oven gas from South Chicago and Indiana steel mills in 1920 and the erection of a coke-oven plant, producing 24 million cu ft of gas a day at Crawford Station. In the late 1920's the base gas supply consisted of 65 million cu ft per day of purchased coke-oven gas plus 24 million cu ft produced oven gas. Peak coverage was by carbureted water gas. During this 530 Btu period, the maximum day send-out increased from 100 to 176 million cu ft and at a faster rate than the average day. This was due to the increased use of gas for auxiliary space heating by means of range ovens, radiant fires, etc. The annual send-out increased from 28 to 44 billion cu ft. A space heating rate of 75 cents per 1000 cu ft or 14 cents per therm (100,000 Btu) resulted in the attachment of considerable space heating where convenience and not price was the principal factor. There was also a vigorous sales program to connect more automatic storage water heaters and to extend the use of gas for industrial purposes

A number of prominent oil companies which had large gas reserves in the Texas Panhandle, together with Peoples Gas, in 1930 formed what is now Material Gas Pipeline Company of America. By the fall of 1931 that company had built a 24-in. pipe line, 980 miles long, to Joliet, Ill. This pipe line with ten compressor stations had an initial capacity of 175 million cu ft per day. The local utilities formed their own transportation company from Joliet to Chicago, constructing two 24-in. pipe lines to the southeastern and to the western boundaries of Chicago. The utilities supplied by Chicago District Pipeline Company were Western United Gas and Electric Company, Public Service Company of Northern Illinois, The Peoples Gas Light and Coke Company, and Northern Indiana Public Service Company.

In common with other midwest gas companies of that time, a mixed-natural-manufactured gas standard of 800 Btu was established in Chicago. The distribution of the 800 Btu mixed gas began October 16, 1931.

The storage of natural gas to be recovered for seasonal peaks has been an outstanding activity of the industry in recent years. While the earliest use of exhausted gas fields to store seasonal peak gas was in 1915, the large-scale development has been in the past 15 years. By 1943 there were more than 50 storage areas in operation with estimated storage capacity of 135 billion cu ft and a daily deliverability of 750 million cu ft. A survey of July, 1952, showed 124 fields in use storing 587 billion cu ft, with 13 fields under construction and 3 more proposed, with a grand total storage capacity of 909 billion cu ft. The largest established fields are in Texas and Pennsylvania with usable capacity of 65 and 60 billion cu ft, respectively.

Cyclic Catalytic Reforming of Natural Gas, by G. L. Calderwood, Rochester Gas and Electric Corporation, Rochester, N. Y. 1953 ASME Fall Meeting paper No. 53—F-19 (mimeographed).

WITH natural gas becoming available in new areas, a utility may now choose between converting all appliances to the new fuel or, by employing catalytic processes, converting the gas instead. This paper is a discussion of the development by the American Gas Association of processes for catalytically reforming natural gas with steam. The resulting gas is high in hydrogen and possesses good burner characteristics.

The cyclic catalytic reforming process used in Rochester, N. Y., is discussed. Advantages found to be inherent in this process are stated as: (1) High thermal efficiency, (2) demonstrated ability to use substitute hydrocarbons, such as naphtha, in case of a curtailment in natural-gas supply, (3) low investment per million cu ft of gas produced.

The author titles this change a "revolution in an old industry." He states that proved U. S. reserves of natural gas as of December, 1952, were 199.7 trillion cu ft. With no further discoveries and a constant annual consumption of 8.6 trillion cu ft, these reserves would last for 23 years. The volume of natural gas now consumed annually would be equivalent to a blanket of gas one mile in thickness covering all of the continental United States.

For 100 years the basic raw materials for manufactured-gas utilities have been coal, coke, and oil. Twenty-five years ago the increased acceptance of coke for domestic fuel and a promising market for other by-products led to the construction of coke ovens in many major cities. But coke ovens have a limited life. To replace a worn-out coke battery today would require more than twice the original investment. Rising coal, freight, and labor costs have also entered the picture, as have decreased by-product revenues.

To use straight natural gas, every burner on every appliance on the premises of every customer must be altered. The cost of appliance conversion now runs between $20 and $35 per domestic customer. Appliance conversion is a nuisance to the consumer, and return trips must be made occasionally before the customer is satisfied. In an industry alert to further good public relations, this is a disadvantage.

Industrial application has proceeded along two paths: (1) Continuous processes, in which hydrocarbon, steam, and air are reacted in externally heated nickel or carborundum tubes filled with catalyst, and (2) a cyclic process in which blast products and reactants pass through the catalyst alternately.

Advantages common to both types are: (1) High thermal efficiency, (2) process can use substitute fuels in event of a curtailment in natural-gas supply, (3) gas produced requires no purification, (4) there is no tar or waste-disposal problem, and (5) low investment cost per unit of output.

Advantages of continuous processes are: (1) Precision to control, and (2) uniformity of product.

Advantages inherent in the cyclic process are: (1) With heating and make gases passing alternately through the catalyst, the bed is kept active and free of carbon deposition, (2) heat and make gases pass through the same waste-heat boiler, further reducing capital investment, and (3) demonstrated ability to reform higher hydro-

carbons, such as naphtha, in the same apparatus in case of emergency.

Properties of Residual Petroleum Fuels, by W. Sacks, McGill University, Montreal, Quebec, Canada. 1953 ASME Fall Meeting paper No. 53—F-1 (in type; to be published in Trans. ASME).

IT is the aim of the present paper to bring together the published information on the nature of residual petroleum fuels, widely scattered in petroleum and engineering journals. It will be seen that these fuels generally exhibit a more complex behavior in comparison with heavy-distillate fuels.

Although fuels derived from petroleum-process residues have been used extensively for many years, considerable confusion still exists as to their characteristics. As essentially cheap by-product fuels, they have not received a great deal of attention in the past. In recent years their use in gas turbines and diesel engines has emphasized the need for a better understanding of their properties and behavior in combustion chambers.

Coal-Handling Facilities for Milliken Station With Automatic Remote-Control Features, by H. C. Schweikart, Mem. ASME, Gilbert Associates, Inc., Reading Pa. 1953 ASME Fall Meeting paper No. 53—F-28 (mimeographed).

THIS paper describes the coal-handling facilities being designed for the Milliken Station near Ithaca, N. Y., incorporating some automatic features which it is expected will result in lower installation and operating costs. The initial unit has a nameplate rating of 135,000 kw maximum capability and is designed to operate at 1800 psig, 1000 F throttle, and 1000 F reheat steam temperature.

While the ultimate capacity of the station has no definite limit the designed ultimate capacity is 500,000 kw. However, study drawings of the property have been prepared showing six units with a total maximum peak generation of 1,000,000 kw.

The station is designed to burn pulverized bituminous coal originating in western Pennsylvania, Ohio, and West Virginia and delivered by railroad. The coal varies in size from 2 in. to slack and the limits of each constituent on an "as received" basis are listed in this paper.

Coal-handling facilities ranging in cost from $5 to $20 per installed kw and averaging approximately 7 per cent of the total power-plant cost have not made their fair share of progress in reduction in cost of equipment and operating labor, improved load factor, and extension of automatic operation, according to the author.

He adds further that during the past decade the capacities, pressures, temperatures, and efficiencies of individual turbine generators, steam generators, and associated auxiliaries have increased considerably, resulting in lower savings of installation and maintenance costs per kw and requiring fewer operators. This progress has been accomplished by fundamental changes in design but aided to a considerable extent by more and better controls, primarily automatic or at least remote manual. By contrast, in general, as the larger units required greater quantities of coal, the capacities of the bunkers, belt conveyers, crushers, feeders, etc., have been merely correspondingly increased with the usual intermittent, manually supervised operation confined to approximately 40 hr each week.

Combustion Efficiency Versus Cyc Length of Domestic Oil Burners, by J. R. Akerman, E. A. Farber, Jun. ASME, and G. L. Larson, Fellow ASME, University of Wisconsin, Madison, Wis. 1953 ASME Fall Meeting paper No. 53—F-20 (mimeographed).

THIS paper presents results of efficiency tests on specific oil burners considering losses due to combustible material in the stack gases, etc., which are not commonly accounted for. The efficiencies decrease, reaching a minimum, and then increase again with cycle length. This variation as shown in this paper, when based upon combustion-chamber surface temperature can be predicted accurately, quantitatively, as well as qualitatively.

This study is one of a projected series of long-range studies of the factors which affect the operation and efficiency of pressure-atomizing oil burners.

The authors observe that the efficiency of an oil-burning unit is one of the factors which determines the net heat output of a system and also the amount of oil which is burned during a given period of time. It has been noted many times, however, that there is poor correlation between the average performance of an oil burner as shown by the oil consumption and the efficiency as determined by methods which commonly have been accepted as correct. This study was made to investigate factors which might be critical in establishing the combustion efficiency and which are not taken into account by the commonly used methods. The authors also intended to find out how much these factors affect the efficiency when the burners were operated on the type of relatively short cycle which is now in such common use.

A review was made of the theoretical work on the combustion of oil and on the commonly accepted concepts of efficiency testing. It was decided that while these commonly accepted methods are quite adequate for some purposes, they do not reflect all the factors which affect efficiency under the wide variety of operating conditions now encountered by oil burners of the type under study.

The authors found it to be most convenient for purposes of this study to use a somewhat different definition of efficiency, and a method of testing was developed for the accurate determination of the efficiency as defined. The results seem to lead to a better understanding of several of the factors which critically affect the efficiency of the combustion of oil. It can be shown also that the variations in efficiency with different cycle lengths, which on first glance appear to be quite illogical, can be explained rationally.

Lighting-Off and Starting-Up Precautions for Stoker-Fired Boilers, by Herbert W. Andrews, Eastman Kodak Co., Rochester, N. Y. 1953 ASME Fall Meeting paper No. 53—F-18 (mimeographed).

THIS paper outlines precautions taken to assure that the units of an industrial power plant, burning 1/3 million tons of coal per year on underfeed and chain-grate stokers, are prepared for use. The plant issues operators' written start-up procedures with check sheets compiled in conjunction with equipment manufacturers, thereby protecting equipment and reducing hazards to operators during the critical start-up periods.

The Eastman Kodak Company, in its manufacturing processes, requires extensive air conditioning and cleanliness. The power division must avoid creating a dust nuisance which might contaminate the products. Underfeed and chain-grate stokers were selected because of their inherent low-stack emission, because it is unnecessary to crush or pulverize the fuel, and because their soot and ash are of such size consist as to be disposable without special handling precautions.

Safety, continuity, high availability, and trained personnel are stressed in power-plant operation. The precautions and procedures used in preparing and starting up boiler-stoker units indicate the details to which the program is carried out.

The type and size of units installed and the fuel burned out are outlined in this paper. During the outage and prior

to start up, tests are made to disclose sources of trouble which otherwise might not be apparent until units are in operation.

Installation of Fuel-Gas Piping on Premises of Industrial Consumers, by E. L. Spanagel, Rochester Gas and Electric Corporation, Rochester, N. Y. 1953 ASME Fall Meeting paper No. **53—F-17** (mimeographed).

FUEL-GAS piping on premises of industrial consumers is covered partially in the Code for Pressure Piping, ASA B31.1. However, the material covered in that code is not sufficiently detailed for practical application. This paper reports on progress toward the preparation of a comprehensive standard for such work. It is intended to cover proper methods and procedure for the layout, installation, and testing of piping systems for distributing fuel gas within the premises of an industrial plant.

Eventually this may be used as the basis for American Standards to cover installations of consumer-owned gas piping and equipment on the premises of industrial and commercial consumers—those not now covered by ASA Z21.30-1950, which pertains to the installation of gas piping and appliances in building, but which covers only residential and commercial consumers and applies only to gas at low pressure (not in excess of $^1/_2$ psi).

The author maintains that it is self-evident that the mechanical details of an industrial fuel-gas piping system would not be essentially different from that of any other piping system in industry. However, fuel-gas piping must not be located where it may be subjected to freezing or changing temperatures, must not be placed in cinder fill or other destructive soil without some form of corrosion protection, and must always be so located that gas leakage, if any, readily will be detected. Testing, purging, and locating of leaks in a fuel-gas system should be handled in accordance with accepted procedures as recommended by the American Gas Association. Probably the most important single factor in the design and layout of an industrial fuel-gas piping system and the one in which there are more possibilities for error is in the determination of adequate pipe capacities. It is for this reason, therefore, that particular emphasis has been placed on this phase of the subject. Furthermore, the author definitely recommends that the design of a fuel-gas piping system be placed in the hands of a competent, experienced engineer who is familiar with the various factors which influence the pipe-size determinations. By observing this policy and/or working in close co-operation with the engineers of the public utility company supplying the fuel gas, the industrial consumer can be assured of adequate gas-pressure conditions throughout the plant. This is most important because the satisfactory operation of industrial-gas appliances and equipment depends primarily upon a supply of clean fuel gas delivered to the point of use and at a pressure which is held uniformly at the value for which the equipment was designed.

Heat Transfer

Rapid Measurements of Thermal Diffusivity, by G. E. McIntosh, General Electric Company, Schenectady, N. Y., D. C. Hamilton, Jr., Mem. ASME, Oak Ridge National Laboratory, Oak Ridge, Tenn., and W. L. Sibbett, Jun. ASME, Purdue University, Lafayette, Ind. 1953 ASME Fall Meeting paper No. **53—F-3** (mimeographed, to be published in Trans. ASME).

THIS paper describes the development of an apparatus and a technique for determining the thermal diffusivity of metals by a periodic heat-flow method. Measurements with a probable error of ±6.8 per cent were made on specimens of Armco Iron, titanium, zirconium, and Haynes Stellite 25 at temperatures of 456, 564, and 672 R.

The object of this investigation was to evaluate experimentally the periodic transient method of determining the thermal diffusivity of metals. This investigation was initiated in February, 1949, and continued over a period of more than three years.

A Stable Numerical Solution for Transient Heat Flow, by George Leppert, Jun. ASME, Illinois Institute of Technology, New Lenox, Ill. 1953 ASME Fall Meeting paper No. **53—F-4** (mimeographed).

AN IMPLICIT finite-difference formula for the numerical integration of the heat-conduction equation is described in this paper. It is shown to offer considerable saving in computing time compared to previously used methods for some types of problems. A simple algebraic procedure is developed which facilitates the computation on a desk-type calculating machine and removes the necessity for either iteration or tedious successive substitution at each time step. The accuracy of the method is discussed in terms of its convergence and stability with the aid of a simple example whose analytical solution is known. Although the outstanding advantage of the new method is its stability for large time steps, its convergence error also tends to be smaller than for the explicit formula usually used in these problems.

The object of this paper is to describe the recently developed numerical method for the solution of partial differential equations of the heat-conduction type and to show how this procedure may be applied simply to certain type of engineering problems.

Thermal Lags in Flowing Systems Containing Heat Capacitors, by J. Wilford Rizika, Jun. ASME, Cambridge, Mass. 1953 ASME Fall Meeting paper No. **53—F-8** (mimeographed; to be published in Trans. ASME).

THE method of finding the thermal lag in systems, such as heat exchangers and pipes, is shown in this paper, and the case of the parallel-flow heat exchanger also is partially treated. The Laplace transformed solutions are presented. An equivalent treatment of the counter-flow heat exchanger is given.

For the case of a gas flowing, with a step-function temperature input, in an insulated pipe, the percentage temperature change is shown to be independent of the initial temperature potential, for both the gas and the pipe at any time and at any distance from the pipe inlet. It is similarly shown for the case of a gas flowing, with an exponential temperature input, in an insulated pipe, that the percentage temperature change is independent of the maximum temperature potential, for both the gas and the pipe.

Problems involving the thermal lag in gaseous fluid systems containing heat capacitors, such as heat exchangers and pipes, are arising continually in aeronautical, chemical, and mechanical applications where "temperature control" is necessary. This analysis is applied to systems which employ only gaseous fluids (fluids in the vapor phase). The controllability of the fluid-discharge temperature from a system is a direct function of the thermal lag of the system—if a length of pipe connects a fluid source to a sink, the controllability of the fluid temperature at the pipe exit is a function of the thermal lag of the pipe.

This paper presents a method for finding the thermal lag in a parallel flow system with a fluid flowing on each side of a cylindrical heat capacitor, the entire system being insulated. This particular system can be considered as an element of a tube or pipe, in which and over which fluids are flowing, representing an element of a single tube, with its proportion of total fluid flow, in a heat

exchanger. Similarly, if there were no heat transfer to the fluid outside the tube, the system would represent a fluid flowing through an element of an insulated pipe. This latter case is examined in detail since it is easily manageable and is encountered frequently in engineering systems.

Calculation of Transient Temperatures in Pipes and Heat Exchangers by Numerical Methods, by G. M. Dusinberre, Mem. ASME, The Pennsylvania State College, Pa., 1953 ASME Fall Meeting paper No. 53—F-6 (mimeographed; to be published in Trans. ASME).

OWING to the interest shown in the prediction of transient phenomena in pipes and heat exchangers, the author of this paper reports on several such cases. The numerical methods for the solution of these problems exist in a general form in the literature, but it may be of service to research workers and designers to have these methods developed into explicit iteration formulas and computation guides.

This paper is divided into three parts: Part I, a number of typical problems; Part II, the proposed methods of solution, the results, and an estimate of accuracy; and Part III, The Appendix.

The problems discussed are:

1 A metal tube, substantially insulated externally, has a specified initial temperature distribution along its length. A stream of fluid is introduced, at a specified mass-flow rate, with the entering temperature specified in respect to time. The temperature history of the fluid and of the tube metal is calculated.

The initial temperature of the tube metal is taken as uniform and the entering temperature of the gas is taken as constant. This is merely for comparison with another method of solution, and neither condition is a necessary restriction on the numerical method.

2 After the system of Problem 1 has been in operation for some time, the direction of flow is reversed. The entering fluid temperature is again arbitrarily specified with respect to time. The mass rate of flow may be the same as before, or it may be different. (The paper does not take up cases in which the mass rate of flow varies continuously with time.) Again the temperature history is calculated.

The methods of this example may be useful for predicting the performance of valved or rotary regenerators.

3 A heat exchanger is operating under a specified set of conditions. A change is imposed on the entering temperature of one or both of the fluid streams. The temperature history is to be calculated.

This analysis may be useful for predicting starting conditions, or lag effects in control problems.

Erosion by Melting and Evaporation, by Kurt Berman, General Electric Company, Schenectady, N. Y. 1953 ASME Fall Meeting paper No. 53—F-2 (in type; to be published in Trans. ASME).

THIS paper presents an investigation of the erosion of solid bodies placed in an air stream. The test specimens were formed into cylindrical and conical shapes. Ice, acetophenone, and paradichloro-benzene were used as the materials for the solid models. It was possible to correlate the rate of erosion as a function of the Reynolds number.

A record of the erosion process was obtained by taking pictures of the test substance at selected time intervals. The analysis of the photographic plates consisted of measuring, by means of a comparator, the diameter of the specimens at various points along their surface.

The problem of erosion is of sufficient technological importance to have warranted extended study. The word "erosion," as usually employed in the literature, is defined as the destruction of materials by physical effects, while corrosion is the result of chemical or electrochemical action. Although the corrosive and abrasive destruction of metals and other materials has been investigated in great detail, comparatively little interest has been expressed in the erosion of soild surfaces by evaporation and melting. A few workers in the field of heat transfer have considered this type of erosion mechanism. However, their motive was not primarily to study the phenomenon but rather to use the process of erosion as a means for obtaining heat-transfer data.

Steam Power Generation

Design Considerations in Kodak Park's Power System, by H. A. Decker, Mem. ASME, Eastman Kodak Company, Rochester, N. Y. 1953 ASME Fall Meeting paper No. 53—F-9 (mimeographed).

THIS paper presents the design considerations for power-plant equipment in a highly specialized chemical plant producing photographic film and paper products. High-pressure boilers and turbines are used to produce the steam required by the manufacturing plant and generate electrical power on a by-product basis. The nature of the manufacturing processes requires that special attention be given to continuity of operation and plant cleanliness.

It might be said that the generation of steam and electricity is traditional with the author's company. Eastman himself purchased the first generator, then called a "dynamo," in 1881, the year after the present company was founded. This was the same year Edison began the manufacture of incandescent lamps and five years before the first steam utility plant in Rochester began to distribute electricity in a form suitable for motors. This first "generator," engine-driven through a line shaft, could develop about 1.25 kw and was enough for 15 incandescent lamps. In 1882 Eastman purchased a second larger generator and 60 lamps. This unit had a capacity of about 5 kw.

Kodak Park began operations in 1891 with power equipment consisting of two 103-hp, 125-lb pressure, water-tube, hand-fired boilers, a 75-hp vertical steam engine, and an Edison bipolar, belt-driven, d-c dynamo having a capacity of about 50 kw. This generator supplied both lighting and motors. One of the motors operated until last year and is now being moved to the company's "Power Museum." Many boilers and generators have been installed and replaced since this early beginning. The power plant has increased along with the manufacturing plant to meet the increasing production demand and new products.

To describe the present plant briefly; its steam capacity is 1,390,000 lb per hr of steam, of which 740,000 lb per hr is made with four boilers at 800 lb pressure and 650,000 lb per hr with 11 boilers at 260 lb and 210 lb pressures. It has seven a-c generating units with a total capacity of 38,900 kw and three old units generating a total of 3000 kw d-c. Capacity is supplemented by a 9000-kw tie with the local utility. The company has numerous turbines and engines for driving refrigerating compressors, air compressors, fans, pumps, etc., which bring the total equivalent mechanical-electrical power to about 100,000 hp, or 75,000 kw. An additional generator on order, of 12,500 kw capacity, brings the electrical a-c total to 51,400 kw and the total equivalent power to 87,500 kw. The author notes that this unit ultimately will be what amounts to the low-pressure end of a compound

unit with a mile of piping between the high-pressure and low-pressure sections.

This paper attempts to give some of the larger as well as incidental factors in the design of the power plant at Kodak Park and describes the method of making the plant efficient to obtain the lowest possible investment cost within the manufacturing plant limitations. .

Design and Operation of High-Recovery Regenerative-Type Air Preheaters, Part I, by George D. Braddon, Mem. ASME, The Air Preheater Corporation, Wellsville, N. Y. **Part II,** by Joseph Waitkus, Mem. ASME, The Air Preheater Corporation. 1953 ASME Fall Meeting paper No. **53—F-22** (mimeographed).

ACCORDING to the authors of this paper, air preheating has become the most widely accepted method of recovering heat from flue gases of high-efficiency steam-generating units. The drive to further reduce stack losses and up over-all efficiencies continues.

The regenerative air preheater possesses unique characteristics which contribute to its ability to achieve maximum reduction in stack losses while permitting continuous operation over long periods.

The paper deals with those features of the regenerative air preheater which are inherent in this type of heater which is created expressly for the purpose of realizing high efficiency co-existent with high availability.

The purpose of Part I of this paper is to broaden understanding of the regenerative-type air preheater which continues to be one of the most effective means at the disposal of the designer in his striving for higher efficiency of steam generation.

Part II of this paper is devoted to the operation of high-recovery regenerative-type air preheaters from the standpoint of removing deposits and controlling metal temperature.

Emphasis is placed on several requirements for an effective removal of deposits by blowing steam or air and washing with treated water. Attention is directed to the need for a dry-cleaning medium which has stimulated interest in the use of superheater steam and compressed air.

The washing procedure currently recommended assures a higher degree of deposit removal with better protection from acid action. Alkalized or treated water, instead of raw water, accelerates the washing operation and produces a more thorough job.

The control of metal temperature is discussed from several possible arrangements and combinations. The comparison is made of corresponding features and their effect on the operation and efficiency of the plant.

The paper is intended to disclose more clearly the current practices and trends rather than establish new conclusions. The intense interest in supporting higher recovery and attaining a higher degree of availability in the face of a deteriorating fuel situation and mounting fuel and labor costs forces attention to control of deposits and corrosion, and the conditions contributing to their presence in the air preheater.

Russell Station Reheat Unit Design and Operating Experience, by Irwin G. McChesney, Mem. ASME, Rochester Gas and Electric Corporation, Rochester, N. Y. 1953 ASME Fall Meeting paper No. **53—F-31** (mimeographed).

THIS paper describes the Russell Station Reheat Unit, including special design features for improving operation, along with operating experience. Noise reduction and the elimination of fly ash and dust were important considerations.

The first unit, a nonreheat design, was installed at Russell Station in 1948. Electric load growth in the Rochester area required the completion of a second unit two years later. During this interval, the first unit design was restudied and compared with a reheat design. Plant-wise, the increase in cost of the reheat cycle was small. Some of the items of cost, such as the turbine and increased amount of alloy piping, were offset by the factor of increased efficiency. This increase in efficiency over the nonreheat cycle amounted to about 5 per cent, and for a given station design output, it decreased the heat input requirements, reduced the size of auxiliaries, and the amount of auxiliary power. The over-all aspect of the reheat cycle was favorable and such a design was developed for the second unit.

Centrifugal Boiler Feed Pumps Under Transient Operating Conditions, by Igor J. Karassik, Mem. ASME, Worthington Corporation, Harrison, N. J., G. H. Bosworth, Bechtel Corporation, San Francisco, Calif., and W. D. Elston, Pacific Gas and Electric Company, San Francisco, Calif. 1953 ASME Fall Meeting paper No. **53—F-32** (mimeographed).

SAMPLE calculations for predicting reduction of available NPSH during load reductions together with test data and methods for improving the transient effects and protecting feed pumps are presented in this paper.

For years engineers have been developing power plants to operate at ever-increasing steam pressures and temperatures to improve over-all thermal efficiencies. Therefore the problems introduced by transient conditions have grown in complexity and severity with time. Yet it has only been recently that much concern or even interest has been given to these problems.

One of the few contributions to the literature on this subject was presented in March, 1952, at the American Power Conference in Chicago, Ill. As stated in that paper, it was strictly an interim report and only treated in a general way the conditions encountered during sudden load reductions in plants with open feedwater cycles. It is the intention of the authors of the present paper to complement the theories presented earlier by experimental data, to develop a simplified method of evaluating the relative safety of a given installation, and to enlarge the scope of the field covered by including an analysis of problems which may arise in closed feedwater cycles. In addition, problems akin to those presented by transient conditions and arising from the use of common spare pumps in adjoining units—in either open or closed cycles—are included in this paper.

Turbine Starting and Loading Tests at Dunkirk Station, by E. M. Kratz and R. C. Wiley, Jun. ASME, General Electric Company, Schenectady, N. Y. 1953 ASME Fall Meeting paper No. **53—F-33** (mimeographed).

THE first 3600-rpm tandem-compound reheat turbine manufactured by the company with which the authors are associated was placed in operation at the Dunkirk Steam Station of the Niagara Mohawk Power Corporation, in 1950. Since this was the first of a new type of turbine, both the operating company and the manufacturer were interested in obtaining information on its operating characteristics. Therefore, observations of factors contributing to safe and reliable operation of the turbine, made under transient conditions encountered during normal and emergency operation, are reported in this paper.

The factors involved in the operation of a reheat turbine under transient conditions are the same as those for a nonreheat machine. They result from the effect of steam-temperature changes on the following: (1) The relative position of the rotating and stationary parts, (2) vibration of the turbine resulting from misalignment caused by unequal expansions of the casing, (3) thermal stresses in the casing and valve chests, (4) thermal stresses in the rotor, (5) stresses in the bolts and flanges due to

unequal heating, and (6) heating in the exhaust end at no-load operation.

The object of the tests was to obtain information on the operating characteristics of the turbine during the following conditions: (1) Starting and loading from turning-gear operation, (2) changing load, and (3) tripping load and reloading.

Except for the rates of starting and changing load, the tests were made with normal station operating practices.

Turbine-casing metal temperatures were measured with thermocouples. The thermocouples were connected to a strip chart potentiometer which recorded each temperature at two-minute intervals.

The data obtained on these tests demonstrates the usefulness of metal-temperature measurements to supplement the other turbine supervisory instruments. Maximum rates of change of turbine metal temperatures and related thermal stresses are dependent upon the type of loading and steam-temperature changes as well as their average values. Thermocouple wells are installed in the casings at the points of maximum temperature change in large steam turbines manufactured by the company with which the authors are associated.

The following conclusions from the data obtained on these tests, applying only to the Dunkirk Unit, are listed in the paper as:

1 After the unit has been off the line for a week end or less it can be accelerated from turning gear operation to 3600 rpm as fast as adequate mechanical supervision permits. The time at no load is not an important factor during subsequent loading.

2 After a shutdown of a week end or less the unit can be loaded at 1.5 mw per min with maximum rates of metal temperature rise less than 500 F per hr.

3 Load can be changed 25 per cent of rating instantaneously and 100 per cent of rating at 2.0 mw per min.

4 In an emergency a load of 100 mw can be dumped. When reloading, the unit should be loaded as fast as dry steam can be supplied.

The Solution of Pipe Expansion Problems by Punched-Card Machines, by Lloyd H. Johnson, General Electric Company, Schenectady, N. Y. 1953 ASME Fall Meeting paper No. 53—F-23 (mimeographed).

THIS paper outlines a procedure for the solution of pipe-line flexibility problems by the use of punched-card machines. The procedure can be used for pipe-line systems made up of any number of straight and curved members. Card-handling routine is explained for systems involving up to and including 14 simultaneous equations. The time required for solution varies according to the number of members and branches, but in general, a single-branched problem requires $2^1/_2$ hr while a two-branched problem requires 3 hr.

The calculation of the flexibility of most pipe-line systems is a time-consuming job. Only in the most simple of pipe-line analyses can the operations be performed in a few hours. Usually for systems with a fair degree of complexity, the calculation time is measured in terms of weeks, rather than hours. For any calculation that requires this amount of time, the chances for human error are always present and much time is lost finding and correcting these errors. In addition, the sequence of the operation performed is complicated sufficiently so that only those with a great deal of experience can perform satisfactorily the calculations. This quite naturally tends to overload the few that do the actual calculations and results in delays in the preliminary design stages of the piping system. Ordinarily, a system is worked out that will produce less than the allowable stress, but time cannot be taken to work out a system that will do the job for the least amount of piping. In other words, time cannot be taken to design an efficient system because of the time required to perform the calculations.

It is the purpose of this paper to outline the procedure now used in the author's company for the rapid solution of these pipe-line problems by personnel relatively inexperienced in pipe-line analyses. The solution of problems is resolved into the proper sequence of cards being fed into a punched-card calculating machine. The time required to solve a problem that has been presented in the form of an isometric sketch varies with the number of restraints and members and depends on the time required to transfer information from sketches to cards and the actual machine time. A further breakdown of these times is included in another section of this paper. The solution is good for any number of straight or curved sections of pipe that can be resolved into a working plane perpendicular to one of the co-ordinate axis. The straight sections may be inclined at any angle and the curved sections may have any included angle of arc.

There are a number of recognized and accepted methods of calculating piping stresses, as for instance the "general analytical" method, the "elastic center" method, the "Karelitz - Marchant" method, the "algebraic" method, and the "grapho-analytical" method. The method used in this paper is the general analytical method since the calculation of the constant coefficients of the resulting simultaneous equations readily is adaptable to punched-card machines. Specifically, this paper treats in detail the application of the IBM card-programmed calculator and the accompanying key punch to the solution of expansion stresses and deformations in pipe-line systems.

Instruments and Regulators

Study of Cubic Characteristics Equation by Root-Locus Method, by Yaohan Chu, Ford Motor Company, Dearborn, Mich., and Victor C. M. Yeh, Gulton Manufacturing Corporation, Metuchen, N. J. 1953 ASME Fall Meeting paper No. 53—F-21 (mimeographed; to be published in Trans. ASME).

IT is shown in this paper that all possible roots of a cubic characteristic equation lie on a portion of a hyperbola and of its axis. This hyperbola readily may be sketched from the values of the coefficients of the cubic equation. Hence the change of the roots of the cubic equation due to any change in its coefficients may be visualized. The discussion of the transient response in relation to possible root-configurations is included. A root-locus chart is provided for "universal" use. Results from an analog computer are shown to be agreeable with those in this paper.

The behavior of a linear system, whether it be a feedback control system, a lumped-parameter network, the dynamics of an aircraft (linearized), etc., may be described by a linear ordinary differential equation with constant coefficients. The complementary solution of this differential equation gives the transient response of the system. If Laplace transformation is employed, this equation becomes a complex algebraic one. Its transient response is determined by the roots of this complex algebraic equation, which is often called the characteristic equation of the system.

For the cases of first and second-order equations, their results are well known and serve as the fundamentals for those who are working in this field. For the cases of third-order equations, methods for extracting roots are available, and charts for choosing the values of constant coefficients for certain desirable roots are also available. However, the exist-

ing technique does not provide a clear picture about the influence of each constant coefficient of the cubic equations upon its roots, as one would have for the cases of first and second-order equations.

This paper attempts to demonstrate that all the three kinds of information are obtainable by means of the root-locus method, thus providing a better approach for synthesis of third-order systems. Emphasis is laid on the third one, which is the influence of each constant coefficient upon the roots. Once the values of these constant coefficients are related to the parameter of the system, the authors believe, one will be able to visualize the nature of response and to know which coefficients of the cubic characteristic equation should be modified in order to achieve a desired response. It is hoped by the authors that this paper will present the reader a view such as one would obtain by merely examining the values of the constant coefficients of the first and second-order equations.

Static Flow Characteristics of Single and Two-Stage Spring-Loaded Gas-Pressure Regulators, by A. S. Iberall, Mem. ASME, The Aro Equipment Corporation, Cleveland, Ohio. 1953 ASME Fall Meeting paper No. **53—F-5** (mimeographed; to be published in Trans. ASME).

THIS paper attempts an investigation of gas-pressure regulators of greater completeness than usually presented. Emphasis is placed on the application of the theory to their design. The analysis is summarized in graphical form in which the characteristics of the regulator may be obtained by ruler and compass constructions. Brief attention is given to the errors inherent in the simplifications made in the analysis.

Although the gas-pressure regulator is a widely used instrument, its theoretical exposition has received incomplete attention. It is the purpose of this paper to provide a somewhat more complete elucidation of the characteristics of the spring-loaded gas-pressure regulator.

The Study of Transients in Linear Feedback Systems by Conformal Mapping and the Root-Locus Method, by Victor C. M. Yeh, Gulton Manufacturing Corporation, Metuchen, N. J. 1953 ASME Fall Meeting paper No. **53—F-7** (mimeographed; to be published in Trans. ASME).

THIS paper points out the correlation between frequency and transient analysis of linear feedback systems, either degenerative or regenerative, through conformal mapping. A method for deriving the equations of root loci is presented, and the basic shapes of root loci are shown. The shifting and reshaping of root locus by means of controller adjustments are discussed.

The technique of conformal mapping has provided a powerful tool in modern engineering; this is especially true in the analysis and synthesis of linear feedback systems. It will be shown that the frequency and transient response methods are based on two conformal transformations—a direct and a reverse transformation. The transfer locus on the one hand and the root locus on the other are the most useful information obtainable through the two-way transformation. The information yielded from one transformation tends to complement that of the other. Only by performing the two-way transformation may one obtain complete information regarding the dynamic behavior of a linear feedback system.

Management

Standard Data Problems and Solutions, by Gerald Nadler, Mem. ASME, Washington University, St. Louis, Mo. 1953 ASME Fall Meeting paper No. **53—F-16** (mimeographed).

NEW statistical techniques on time studies are presented in this paper to point out how data problems can be solved. With these techniques, standard data becomes a more accurate and consistent tool for work measurement.

Work measurement is greatly simplified if time studies are converted to elemental standard data. If the time-study procedure used is such that the errors are minimized, standard data offers an economical means of determining work loads.

The time-study procedure is reviewed briefly to indicate where and how errors can be reduced. The problems of standard data are: (1) Are the variations of base times within satisfactory limits? (2) Is there a factor present affecting the times? (3) What is the factor? (4) Is the curve drawn the proper one?

According to the author, industry needs work measurement. To become more efficient and productive, procedures in an organization must be established for determining the amount of time operations require. A well-run company depends directly on such times for production planning, production control, balancing production lines, determining manpower requirements, determining proper man-machine relationships, determining wage incentives, etc. Most of these functions must be performed in a plant. In some organizations, these functions are met by "guestimates" and past production performances. However, these estimates and production records allow for many errors in the future planning. As a matter of fact, inequities in procedures and systems frequently are perpetuated by these estimates. Even if a company does not have wage incentives, these functions are essential. Work measurement has grown in recent years to become the tool for proper determination of times of operations.

Industrial engineering has developed the tool of time study. The purpose of time study is to determine the amount of time an operation should take under certain conditions as specified in a particular plant. A time study on a job determines the work load for that job only. Standard data enters the picture by arranging time values to predict the amount of time an operation should take without taking a time study and sometimes before the job is even in existence. It is the purpose of standard data to reduce the amount of time necessary in determining work loads on many plant operations. Therefore, time study is necessary before standard data can be derived. With both time study and standard data, the objective in industry is to arrive at as accurate a work load as possible for each operation. In practice this usually means that standards are not completely accurate but that the standards have sufficient accuracy to be compatible with the economic requirements of a plant.

The Theory and Practice of Standard Data, by Adam Abruzzi, Stevens Institute of Technology, Hoboken, N. J. 1953 ASME Fall Meeting paper No. **53—F-25** (mimeographed).

THIS paper examines the assumptions that must be satisfied to make standard-data estimates valid, showing how and why current procedures fail to satisfy these assumptions.

The objectives and basic approach in developing standard data were first proposed by Taylor in the early part of this century as an integral component of his time-study or, more generally, work-measurement procedures. Taylor proposed essentially that operation element times be determined by observing skilled operators with a stop watch. These time data were then tabulated for the purpose of predicting cycle times for operations with similar elements, where the predicted values were to be obtained by adding the recorded time values for the elements involved.

The basic steps currently used for

developing standard data are essentially based on Taylor's recommendations. According to almost all time-study writers, the standard-data method consists of subdividing operations into what are considered to be homogeneous elements. A set of observations is then taken on usually arbitrarily selected workers; the time data obtained are then summarized, say, by computing their arithmetic average. This summarized value is then normalized subjectively by the observer who attempts to estimate the value that would have been obtained if an "ideal" worker had been observed. The normalizing or—as they are usually called—rating procedures used vary considerably in detail. However, they are invariably based on the observer's judgment and have been found to involve a potentially large error in precision as well as in accuracy.

Although almost all writers on the subject agree on the basic steps, the specific procedures they recommend for developing standard data vary widely. As one instance, the element definitions given by Morrow state that elements should be as small as possible in standard-data applications. Barnes' definition is equally descriptive, and vague; he says that elements should be so defined as to permit standard data to be developed. As might be expected from these representative definitions, a wide variety of descriptive criteria has been reported by practitioners in a comparatively recent survey.

The findings of this paper make it clear that there is only an extremely small likelihood of developing standard data that is precise and accurate in the scientific sense. It is likewise clear that the claims made for standard data are not substantiated in practice; indeed, the problems involved in developing standard data with predictive value are scarcely realized by writers and practitioners alike.

The empirical consequence of this is that a decision will ultimately have to be made by the industrial society between two alternatives. The first is to retain standard-data procedures as empirical guides for solving certain essentially bargaining problems of management and labor. If this decision is made, it should be made with the full understanding that the results obtained are essentially value judgments with little predictive value.

The second alternative is to develop standard data meeting the criteria of scientific inference, particularly those concerned with defining a precise prediction. As the preceding material indicates, this has almost no likelihood of success except in special cases. This means that other work-measurement procedures will have to be used to obtain the time values that it had been hoped standard data would supply.

It is the writer's view that, ultimately, the decision will have to be in favor of the second alternative. Thus, the continuous improvements in technology leading to mechanical planning and control of industrial operations means, among other things, that accurate and precise estimates of production rates of different operations will be required. Such estimates cannot be obtained by relying on the judgments of those acting as advocates of vested viewpoints; they can only be obtained by following the rules of scientific inference.

Activity Sampling and Analysis—Its Theory and Practice, by Harold O. Davidson, Ohio State University, Columbus, Ohio. 1953 ASME Fall Meeting paper No. 53—F-24 (mimeographed).

THIS paper is concerned with activity sampling and analysis techniques as applied to practical problems of forecasting and operations improvement. It presents a brief historical review of theoretical development, and a critique of the ratio-delay technique of activity study. Analytical deficiencies of the ratio-delay procedure are noted, and suggestions are offered for their correction.

Activity sampling and analysis techniques provide a method whereby one may estimate the proportions of total activity time—of machines, persons, or systems—which are devoted to various subclasses of the total activity. Under certain assumptions, estimates of this sort also may constitute reasonable forecasts of what those proportions will be in some future period. In order to obtain reliable estimates, however, a certain amount of analysis is required. When appropriate analytical methods are applied correctly they are not only of value in assuring the reliability of estimates but also may produce other information which is directly useful in improving operations. Thus, analysis performs the dual functions of validating the assumptions on which estimates and forecasts are based and of providing other information which is relevant to personnel and equipment utilization. The importance of the analysis does not appear to have been appraised fully in the literature which has appeared on the subject in this country.

Various practical objectives of activity studies have been suggested by a number of authors, and include problems such as: (1) Improving manpower utilization, (2) developing bases for more accurate apportionment of indirect labor costs, (3) forecasting net productive time as a basis for production planning, (4) developing delay allowances in time standards, and (5) improving equipment utilization, etc.

Since this paper stresses analytical deficiencies of the prevalent ratio-delay technique, it concludes with an indication of how these deficiencies might be remedied, suggesting a number of other statistical methods not previously applied. Techniques listed are (1) Analysis of variance by ranks, (2) various non-parametric methods, and (3) binomial probability paper.

It is the author's belief that these will serve the needs in a large number of cases and in view of the fact that their application usually will require a small amount of time relative to data collection, it is expected that they will be regarded with favor by engineers as a means of remedying some technical deficiencies of ratio-delay.

ASME Transactions for November, 1953

THE November, 1953, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Quick-Starting of Large High-Pressure High-Temperature Boilers, by J. C. Falkner. (52—A-120)

DISCUSSION

Controlled Starting of Steam Turbines, by R. L. Reynolds.

Factors Involved in Starting and Subsequent Loading of Modern Steam Turbines, by C. W. Elston.

Quick-Starting of High-Temperature High-Pressure Boilers, by A. R. Weismantle.

Quick-Starting of Steam Turbines, by C. D. Wilson

General Discussion

Symposium on Heavy Presses for Light-Metal Forgings and Extrusions—Introduction, by J. C. Ward, Jr.

Requirements for Large Light-Metal Forgings and Extrusions in the Aircraft Industry, by G. W. Papen. (52—A-75)

Design and Construction of Large Forging and Extrusion Presses for Light Metals, by M. D. Stone. (52—A-76)

Metallurgy and Production of Suitable Aluminum-Alloy Ingots for Large Forgings and Extrusions, by T. L. Fritzlen. (52—A-77)

Large-Forging-Press Operations and Production Problems, by G. W. Motherwell, J. R. Douslin, and A. L. Rustay. (52—A-78)

Large-Extrusion-Press Operation and Production Problems, by T. F. McCormick. (52—A-79)

DISCUSSION

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

100 Years Ago

To the Editor:

The following paragraph is taken from an article on the *Steam Engine* in Luke Hebert's "Engineer's and Mechanic's Encyclopaedia. ." p. 689, published in 1842:

"The stupendous effects which, during the short period of one century, have resulted from the application of this power, are striking attestations of the value of the labours employed in the invention. By the agency of steam, the seas are now navigated in defiance of winds and tides; the earth made to yield up in lavish abundance its metal and mineral treasures; vast marshes are drained, and land, before barren, rendered fruitful; communities are brought into closer connection with communities; fresh and inexhaustible sources of wealth and comfort are elicited; new combinations of human industry and ingenuity brought into requisition; knowledge is widely scattered abroad by the extension of letters; distance is lessened by velocity of locomotion; and time itself becomes more precious and invaluable. Thus, by infinitely enlarging the sphere of useful action to whatsoever was useful before, and by diffusing among millions what previously was attainable only by the few, it has wrought a change of aspect in kingdoms, in commerce, and the individual relations of society, to an extent so wide, and in a time so brief, too, that the history of the world affords no parallel to it in influence. . . ."

I think it is of interest to note the impact at that time of steam power especially as regards transportation—less than a dozen years after the famous Rainhill locomotive competition which has been accepted as the final victory of steam over horses as a form of railroad motive power and but four years after the pioneer transatlantic voyages of the steamships *Sirius* and *Great Western*.

Sidney Withington.[1]

[1] New Haven, Conn. Mem. ASME.

Developing Engineers Into Executives

Comment by E. R. Heiberg[2]

Under the foregoing title the author speaks of the difficulties of understanding and practicing leadership.[3] In describing the engineer executive, he says, "Like the military officer he may lead by virtue of his title, position, and status without any particular perception of the emotional state of the person who receives orders and is expected to carry them out." Also the author states, "Military commanders seem to get results more by virtue of an Act of Congress than through their own skill as democratic leaders."

The obvious implication from these statements is that officers in the military service are not qualified to lead men, that they have no regard for the individual feelings and emotions of the men in the service, and that they would not be able to get results if it were not for the authority vested in them by Act of Congress. While we certainly do not say that all military officers discharge their responsibilities with due regard for the human-relations factor any more than do all civilian executives, we do say that the majority of military leaders have great concern for the personal problems and feelings of their subordinates. The concern with which higher commanders regard this is well illustrated in two speeches which are mentioned as follows:

In a talk at West Point in 1946, General Maxwell Taylor, presently commanding the Eighth Army in Korea, made the following statements: "If you read the pages of history with reflection, you find that no man ever rose to military greatness who did not succeed in convincing his troops that he put them first, above all else. . . . The badge of rank which an officer wears on his coat is really a symbol of servitude—servitude to his men. . . . I would mention as the second attribute of the successful leader the gift of human understanding, the ability to treat men with understanding as individuals and not as army serial numbers."

In a speech at Fort Belvoir, Va., in May, 1953, Major General S. D. Sturgis, Jr., Chief of Engineers, U. S. Army, made the following statements: "Here I must state that neither bars nor stars makes an officer. An individual becomes an officer only when he develops those inner qualities of honesty, self-sacrifice, and attention to duty that are always inherent to real leadership. . . . The officer who quietly and unostentatiously sees that his men are fed and bedded down during a cold wet bivouac before he touches a mouthful of food is in this class, and in turn his men will follow him confidently to the ends of the earth."

A further proof of the importance the Army places on proper leadership may be found in the fact that every service school up through the Command and General Staff College includes specific instruction in this subject. At the United States Military Academy, cadets receive a three-year course in Military Psychology and Leadership. This course appropriately starts with instruction in psychology during sophomore year in order to lay the foundation for an understanding of human behavior. It ends with instruction on several principles of leadership through the study of actual case histories of leadership problems. Thus the newly commissioned 2nd lieutenant from West Point has been impressed with the fact that a military commander is a leader only if he gives full concern and consideration to the human-relations factor. As he progresses through the Army school system, he continues to receive instruction on the subject. I do not believe the author can point to comparable instruction on this subject in either the undergraduate or postgraduate training of civilian engineers.

Men in the military service recently have been subjected to an indiscriminate barrage of criticism, much of which is undeserved and some, like that in the cited paper, without any attempt at substantiation. Having served as an engineering executive in the headquarters of both General MacArthur and General Hap Arnold during the war, I appreciate the main theme of the paper. However, like many thousands of men who have

[2] Colonel, U. S. Army, Head, Department of Mechanics, United States Military Academy, West Point, N. Y.

[3] "Developing Engineers Into Executives," by R. F. Pearse, Mechanical Engineering, vol. 75, September, 1953, pp. 719–722.

devoted their lives to the military service of this country, I strongly resent the sweeping and unsupported accusation of incompetence in our military leadership.

AUTHOR'S CLOSURE

I appreciate the opportunity given me to reply to Colonel Heiberg's interesting comment. It enables me to amplify the point I was attempting to make in the section of my paper to which he has referred. To me, it has an important implication for engineering executives.

When the paper was originally prepared, this section was considerably longer. I intended using the modern business enterprise as a model of a particular type of social institution which has certain kinds of leadership patterns and work relationships that are in the process of being developed out of a quite different original structure. Attention was to be particularly called to the rapidly growing emphasis on human relations in modern industry and to the tendency for workers at all levels in a company to have greater voice and participation in policy decisions. It was suggested that the engineering executive who works in such a situation will have to have personality qualities that will enable him to fit comfortably into such a leadership pattern if he is to be maximally effective.

By way of comparison, I intended to refer to the military unit as a somewhat different type of social organization and draw some inferences about leadership therein along the lines that Willard Waller has discussed in his concept of the "institutional leader." In order to make the length of the final paper conform to ASME meeting requirements, it was necessary to reduce this section drastically, along with some other parts of the original draft.

If the section as printed seemed to imply any sweeping categorization of military leaders as being deficient in personal leadership characteristics, I must apologize to Colonel Heiberg for an unintentional oversight on my part. A similar apology also would be due every officer whose conduct exemplifies the qualities set up for the ideal military leader in Colonel Heiberg's letter. These men have been largely instrumental in saving our country's freedom on numerous occasions. None of us can ever express enough gratitude for what they have done.

The main thing I was attempting to get at in this section is that the present degree of voluntary participation in industrial work constitutes quite a new pattern of working relationships. For most people, much of it has come about during the past 50 years. A lot of it has been developed during the past 20 years. Industrial supervisors and executives are currently involved in adjusting their individual leadership methods to these new and rapidly changing patterns.

Throughout most of human history, the master-slave relationship was perhaps the predominant relationship between the leaders and the led. Most civilizations, including those of ancient Greece and Rome, were founded on a slave society. In these relationships, the masters could pretty well dictate how, when, and where their slaves would work. They could force compliance by whatever coercive measures they had at hand, subject only to some degree of public opinion and a prudent consideration for the economic consequences that might result from injuring their human chattels.

Interestingly enough, it was the engineer-scientists of the past few centuries who broke this age-old pattern of human work relationships. It was done by the simple process of harnessing mechanical and physical forces to create the industrial revolution. We are told that in order to have skilled mechanics and machine operators, it was necessary to teach people who did these things to read and write so they could follow simple instructions accurately. Once the broad mass of men became literate and used their learning to run the machines, they also began to think about the existing political, social, and economic conditions governing their employment. What they did about changing these conditions is a matter of very recent history. As recently as 1860 we had master-slave relationships in America in economic institutions of the period.

During the past few decades all this has changed. Contemporary industrial work relationships are on an increasingly voluntary and individual participation basis. If a machinist decides he wants a job, he can go to any company that needs men with his skills. If they are hiring and he qualifies, he starts to work. Once on the job, he has a number of valuable prerogatives as a free man which are not granted to slaves in a slave society. If he does not like his work for any reason, he can quit. He is free to move about in industry as he chooses. If he feels his supervisors are not leading him in a democratic manner, he can file a grievance. This will be dealt with on its merits through the various steps of the grievance procedure. If he and his fellow workers are not satisfied with the final decision, they can strike and thus exert economic pressure on the company.

The engineering executive who directs such men has to adapt his own leadership to these new work relationships if he is to succeed. Employee turnover, costs, scrap rate, absenteeism, tardiness, and other conditions that in part result from the way workers feel about their jobs are all indexes of work satisfaction.

We find that personal and individual leadership on the part of supervisors has much to do with the enthusiasm people have for their company and their work. Morale surveys pinpoint departments in which poor morale exists. More and more, an engineering executive has to be responsive to people's feelings in work situations if he is to advance and succeed in getting results through others.

What happens when the machinist just mentioned is drafted into the military service? Notice that he is probably drafted, since for the past ten years or more we have been unable to get enough volunteers to man our military forces. He is subject to punishments set forth in the Articles of War for refusing to obey any legitimate order issued to him by a superior officer or noncommissioned officer. The machinist—and other American civilians like him for all walks of life—are accustomed to the leadership patterns of an industrial society where they have some voice in what goes on. Management takes cognizance of their feelings. Many may not be happy about being forced to fit into the work-relationship patterns of the military system, because these are different from civilian work patterns.

Colonel Heiberg might well say two things at this point. First, that it is impossible to force men to act as they must in order to fight as a unit to win wars without having a rigid, top-down disciplinary structure that will instantly punish disobedience. He may further say that the military system has always provided enlisted men with the right to have their grievances heard if they will go through the proper channels.

How do enlisted personnel feel about the involuntary nature of their work relationships and the institutional leadership that is part of the structure of a military unit as a social organization? We are, of course, granting that the system is administered with considerable personal effectiveness by many individual officers. A military spokesman was recently quoted as having stated that reenlistment rates have dropped to a low of 6 per cent. In other words, 94 out of each 100 enlisted men are not volunteering to renew their enlistments when these expire. Reasons commonly given for this fact are that hazardous duty, low pay and status, frequent transfers, and limited promotional opportunities discourage many men from making a career

out of military service. Yet we can find civilian occupations that do not lack for manpower if not all of these conditions can be shown to exist.

How much of the current attitude toward military service as a career might be due to the fact that American citizens have become accustomed to one set of work relationships and leadership patterns in their voluntary industrial employment; and find a quite different set of relationships in military service? Would it pay us to analyze the personal-leadership characteristics of those officers in units where the re-enlistment rate is considerably above the 6 per cent average? Do such officers administer basic military regulations and policies in a significantly different way than their counterparts in units with low re-enlistment rates? If so, what are the personality factors involved which might make one officer more individual and less institutional in his leadership patterns? How can we select and hold officers who will exemplify the personal leadership qualities which Colonel Heiberg has so nicely set forth? Within the over-all requirement of getting men to fight for their country in time of war, are there ways in which we might modify military-leadership patterns and work relationships to bring them more in line with civilian practices?

Industrial studies indicate that merely exposing an executive to courses in handling people will not make him much more adept as a personal leader unless he has personality characteristics that let him lead comfortably in such a fashion. While training helps to some extent, personal insight into *why* we tend to act toward our subordinates in a particular manner, plus assistance in correcting any undesirable patterns in our actions, will do much more to develop executive leaders in any democratic social institution.

ROBERT F. PEARSE.[4]

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REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Micrometeorology

MICROMETEOROLOGY. By O. G. Sutton. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. Cloth, 5¾ × 9 in., 32 tables, 35 figs., bibliography, name and subject indexes, xii and 333 pp., $8.50.

REVIEWED BY ARTHUR C. STERN[1]

THE first third of this book deals with fluid flow, starting with classical hydrodynamics and proceeding through the concepts of laminar and turbulent boundary layers, Reynolds number, mixing length, and turbulence.

The next third considers heat transfer with particular stress on convection from earth to the atmosphere and radiation to and from the earth. Concluding this third is a 38-page chapter analyzing temperature variation with height above ground in the lower 100 meters of the atmosphere for various times of day and year, and for various surface conditions. Except for this chapter and the one on radiation, the first two thirds of the book is almost entirely mathematical and is almost devoid of empirical or tabular data. A high order of mathematical training is required for a thorough understanding of these parts of the text.

Fortunately, the mathematics eases somewhat in the concluding third of the book which contains the two sections of most interest to engineers. These are the one giving theory, formulas, and empirical constants for wind profiles near the earth's surface, and the one giving similar data on the diffusion of gases, vapors, and dusts artifically introduced to the atmosphere at ground level or from elevated stacks. The book ends with a discussion of natural evaporation from lakes, reservoirs, ponds, and tanks.

Each chapter has its own bibliography. The book has both author and subject index. No examples are worked out. There is no appendix. Of the 35 figures included, only 7 can be used by the reader to help solve problems. However, empirical constants are given in tabular form or in the text.

This is a scholarly work on an important aspect of meteorology. It will, however, be of interest to a rather limited number of engineers.

[1] Chief, Engineering Unit, Division of Industrial Hygiene and Safety Standards, New York State Department of Labor, New York, N. Y. Mem. ASME.

Books Received in Library

AUSBEULIN RECHTECKIGER PLATTEN UNTER DURCK, BIEGUNG UND DRUCK MIT BIEGUNG. (Mitteilungen aus dem Institut für Baustatik an der E.T.H., No. 26). By F. Stüssi, C. F. Kollbrunner, and H. Wanzenried. Verlag Leemann, Zürich, Switzerland, 1953. 35 pp., 8⅞ × 6⅛ in., paper. 6.25 Sw. fr. Eighth of a series of research reports on plate buckling, this publication covers the buckling of rectangular plates under pressure, bending, and combined pressure with bending. Results are given of a mathematical investigation to determine the critical buckling value under various stress conditions and types of support.

AUTOMATIC CONTROL OF HEATING AND AIR CONDITIONING. By John E. Haines. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1953. 370 pp., 9¼ × 6¼ in., bound. $6.75. An introductory textbook which aims to explain and illustrate the basic problems of automatic control in the heating and air-conditioning field and the principles applied in solving those problems. The detailed treatment covers control fundamentals, electric and pneumatic-control circuits, electric and pneumatic-control units, and control equipment for domestic and commercial heating, unit heaters and ventilators, central-fan heating and cooling systems, commercial refrigeration, and radiant-panel heating.

DIESEL ENGINEERING HANDBOOK. 1953 edition. A. B. Newell, editor. Diesel Publications, Inc., New York, N. Y., eighth edition, 1953. 827 pp., 9¼ × 6¼ in., bound. $7.50. As in the previous editions, detailed information is given on the diesel cycle, fuels, engine components, and auxiliary equipment, including some specialized topics such as dual-fuel engines. In this new edition there is a brief chapter on marine diesels and a new section has also been added describing representative American makes and types, with tabulated up-to-date specifications of all makes and models.

ELECTRIC ARC WELDING. By John Benjamin Austin. American Technical Society, Chicago, Ill., 1953. 280 pp., 8¾ × 5¾ in., bound. $4. A comprehensive treatment of the fundamentals and latest techniques of electric arc welding, the equipment used, and applications

in the major fields of welding: hard surfacing, and pipe, machinery, and structural welding. One chapter is devoted to special automatic metal-arc processes, and another describes the common methods of testing welds. The codes used in the various industries are indicated throughout the text.

ENGINEERING METALLURGY. By Bradley Stoughton, Allison Butts, and Ardrey M. Bounds. McGraw-Hill Book Company, Inc., New York, N. Y., fourth edition, 1953. 479 pp., 9¼ × 6¼ in., bound. $7.50. A new edition of a standard textbook on metallurgy for the engineering student or practical engineer. It covers metals as materials of construction, ores and ore treatment, chemical and mechanical metallurgy, corrosion, fuels and furnaces, pyrometry, and the properties, uses and heat-treatment of ferrous and nonferrous metals and alloys. The book now includes material on powder metallurgy, high-temperature alloys, and other relatively recent developments.

EXPERIMENTAL NUCLEAR PHYSICS, VOL. II. E. Segré, editor. John Wiley & Sons, Inc., New York, N. Y., 1953. 600 pp., 9¼ × 6¼ in., bound. $12. This is the second volume of a three-volume work on the experimental techniques and theoretical interpretation of the data in nuclear physics. It includes a treatise on nuclear reactions and an extensive discussion of the properties, sources, detection, and interactions of the neutron. Each treatise with its accompanying bibliography provides the reader with the main results obtained in nuclear physics up to the end of 1952.

EXTERIOR BALLISTICS. By Edward J. McShane, John L. Kelley, and Franklin V. Reno. University of Denver Press, Denver, Colo., 1953. 834 pp., 8¾ × 5¾ in., bound. $12. The subjects treated in this detailed analytical study include the following: the force system of a projectile; measuring aerodynamic coefficients; trajectory calculations; motion of a projectile; launching effects, and so on. Brief chapters discuss problems of bombing and motion of rockets, and an historical appendix briefly traces the development of ballistics theory.

FABRICATED MATERIALS AND PARTS. By Theodore C. DuMond. Reinhold Publishing Corporation, New York, N. Y., 1953. 332 pp., 8¾ × 5¾ in., bound. $6.50. A ready reference work on the methods of manufacturing small parts—casting, forging, extrusion, screw machines, and so on—relating the design, materials, and cost factors. While the book does not go into the details of design and manufacture, it does present sufficient information to afford a selection of those methods which best meet the specific needs of individual cases.

50–100 BINOMIAL TABLES. By Harry G. Romig. John Wiley & Sons, Inc., New York, N. Y., 1953. 172 pp., 8¾ × 7¼ in., bound. $4. This volume gives the tables for positive binomial $(q + p)^n$ where $q = 1 - p$, and covers the range of n values from 50 to 100, in steps of 5, and the range of p values from .01 to .99, in steps of .01. Directions for the use of the tables, including a brief discussion of interpolation, indicate their many possible uses, especially in the field of quality control.

FLAMES. Their Structure, Radiation and Temperature. By A. G. Gaydon and H. G. Wolfhard. Chapman & Hall, Ltd., London, England, 1953. 340 pp., 8¾ × 5¾ in., bound. 55s; $7.70. A fairly advanced discussion of the underlying physical processes in the field of combustion concerned with stationary flames. Writing from the physical rather than the chemical viewpoint, the authors concentrate especially on the measurement of flame velocity, theories of flame propagation, measurement of high-flame temperatures, and ionization in flames.

DIE GEOMETRISCHEN VERHALTNISSE BEI DER HERSTELLUNG UNREGELMASSIGER FLACHEN. By W. H. Gres. Springer-Verlag, Berlin, Germany, 1953. 95 pp., 9⅛ × 6⅛ in., paper. 12 DM. The author's aim is to provide the engineer or mechanician with a way of determining the best and most economical methods for providing irregular surfaces, based on the geometrical and kinematic properties of these surfaces. As a primary aid, a classification of irregular surfaces is provided based on shop experience as well as on the mathematical relations. A practical approach to an often-recurring problem.

GESTALTUNG VON WALZLAGERUNGEN. (Konstruktionsbücher, no. 4.) By Wilhelm Jürgensmeyer. Springer-Verlag, Berlin, Germany, second edition, 1953. 106 pp., 9 × 6 in., paper. 10.50 DM. This treatment of the design of antifriction bearings gives nomenclature, description of modern types of bearings, tables of sizes and load capacities, and the design of bearing positions, covering shaft guidance, race attachment, lubrication, packing, cooling, etc.

HIGHER TRANSCENDENTAL FUNCTIONS, Vol. I. Compiled by the Bateman Manuscript Project at the California Institute of Technology. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 302 pp., 9¼ × 6¼ in., bound. $6.50. An account of the principal properties of several classes of important special functions: the gamma function; the hypergeometric function; Legendre functions; the generalized hypergeometric series, and other generalizations of the hypergeometric function; the confluent hypergeometric function. These extensive and detailed treatments are the work of four outstanding mathematical analysts, and the work is to be carried on in several subsequent volumes.

INTRODUCTION TO POWER SYSTEM ANALYSIS. By Frederick S. Rothe. John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y., 1953. 187 pp., 9¼ × 6 in., bound. $5. A brief account of fundamentals considering the characteristics of the generator, transformer, transmission line, and load. The author covers only those problems associated with the fundamental operating frequency, at the same time thoroughly investigating the transient behavior of the components during disturbances. Worked problems are included.

LABORATORY INSTRUMENTS. Their Design and Application. By A. Elliott and J. Home Dickson. Chemical Publishing Company, Inc., New York, N. Y., 1953. 414 pp., 8¾ × 6 in., bound. $7.50. The chief aim of this book is to provide the research worker with the principles of good design necessary for the construction of instruments in the laboratory workshop. Separate chapters discuss the properties, treatment, and use of various materials; methods of construction to meet special requirements; kinematic design of instruments; sensitivity and disturbing influences; the considerable subject of optical instruments and optical glass; and the use of photography in research.

PHYSICAL CONSTANTS OF HYDROCARBONS. Volume V: Paraffins, Olefins, Acetylenes and other Aliphatic Hydrocarbons. (American Chemical Society Monograph no. 78). By Gustav Egloff. Reinhold Publishing Corporation, New York, N. Y., 1953. 524 pp., 9¼ × 6½ in., bound. $20. Continuing this series of compilations of physical-constants data for individual hydrocarbons, the present volume records, for the aliphatic carbons material not contained in volume I of the series, either data made available since the appearance of the earlier volume or older data not previously included. The major divisions are as follows: alkanes or paraffins; alkenes or olefins; alkynes or acetylenes. Literature sources for the data given are included in each section.

PIPE AND TUBE BENDING. By Paul B. Schubert. Industrial Press, New York, N. Y., first edition, 1953. 183 pp., 9¼ × 6¼ in., bound. $5. A practical manual describing the common methods and the operating characteristics of the equipment used in the bending of ferrous and nonferrous pipe and tubing. The formulas employed for various degrees of bend, and tables for the minimum radii of bends are given. An appendix on tubing classification is included.

PROBABILITY TABLES FOR THE ANALYSIS OF EXTREME-VALUE DATA. (Applied Mathematics, series 22.) National Bureau of Standards. Available from Superintendent of Documents, U.S.G.P.O., Washington 25, D. C., 1953. 32 pp., 10¼ × 7¾ in., paper. $.25. These specialized tables find use in the statistical approach to such practical engineering problems as the study of floods and droughts and the fracture testing of metals and other materials. The explanatory introduction discusses such applications as well as the general method of use of the tables, the method of interpolation, etc.

PUMPS. Types, Selection, Installation, Operation, and Maintenance. By Frank A. Kristal and F. A. Annett. McGraw-Hill Book Company, Inc., New York, N. Y., second edition, 1953. 373 pp., 9¼ × 6¼ in., bound. $6.50. An extensively revised and rewritten edition of a standard text which provides a comprehensive, practical study of the selection, installation, operation, and maintenance of available types of pumps covering a wide range of applications—boiler-feed, deep-well, sewage and sludge, chemicals, oil-field products, and others. Major additions occur in the material on diaphragm pumps, rotary pumps, jet pumps, and special pumps for foods.

REVIEWS OF PETROLEUM TECHNOLOGY. Volume 13, 1951. George Sell, editor. Institute of Petroleum, London, England, 1953. 360 pp., 9¼ × 6¼ in., bound. 50s; $7. Advancements in the field as written up during the year indicated are discussed critically by British specialists under twenty-two major

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

headings covering a wide range of topics, including the following: geology, drilling, production, refining, instrumentation, petroleum gases, lubricants, oils from shale and other materials, and various special products. A considerable bibliography is cited in addition to the literature references accompanying each chapter.

SYMPOSIUM ON CONDITIONING AND WEATHERING. (Special Technical Publication, no. 133.) American Society for Testing Materials, Philadelphia, Pa., 1953. 98 pp., 9 × 6 in., paper. $2.25. A wide range of topics is covered to provide a broad picture for technologists in many lines: the fundamentals of atmospheric elements; air conditioning in the manufacture and testing of textiles; conditioning and weathering of paper, adhesives, plastics, and organic and metallic coatings; outdoor-exposure testing; and accelerated weathering devices.

VERSUCHSBERICHT ÜBER DAS AUSBEULEN DER AUF EINSEITIGEN, GLEICHMÄSSIG UND UNGLEICHMÄSSIG VERTEILTEN DRUCK BEANSPRUCHTEN PLATTEN AUS AVIONAL M, HART VERGÜTET. (Mitteilungen aus dem Institut für Baustatik an der E.T.H., No. 25.) By F. Stüssi, C. F. Kollbrunner, and M. Walt. Verlag Leemann, Zürich, Switzerland, 1951. 156 pp., $8^7/_8 \times 6^1/_8$ in., paper. 18 Sw. fr. A research report on the buckling of heat-treated and hardened plates of Avional M, an aluminum alloy, stressed on one side under uniformly and nonuniformly distributed load. This is the sixth of a series of reports on plate buckling of the Swiss Association of Bridge and Steel Building Contractors.

WANDWARME- UND LIEFERGRAD- MESSUNGEN AN EINEM LUFTKOMPRESSOR. (Mitteilungen aus dem Institut für Thermodynamik und Verbrennungsmotorenbau an der E.T.H., No. 11). By Mahmoud M. Ghoneim. Verlag Leemann, Zürich, Switzerland, 1952. 51 pp., $9^1/_2 \times 6^3/_4$ in., paper. 6.25 Sw. fr. A doctoral dissertation which presents the results of an investigation to determine the coefficient of heat transfer and its influence on compressor operation for different volumes and cylinder clearances and at different piston velocities and compressions. The influence of various other characteristics was also investigated.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting October 18, 1953, and approved by the Board on November 5, 1953.)

CASE NO. 1108–1 (REOPENED)

(Special Ruling)

Inquiry: May annealed alpha aluminum bronze alloy with the following range of chemical composition:

Copper, per cent	88.00 to 92.50
Aluminum, per cent	6.00 to 8.00
Iron, per cent	1.50 to 3.50
Others, max, per cent	0.50

and the following minimum physical properties in the annealed condition:

70,000 psi ult. tens. str.
30,000 psi yield str. at 0.5% elong. under load
40% elongation in 2 in.

and conforming to ASTM B-169-49T Alloy D, be used in the construction of unfired pressure vessels under the provisions of Section VIII of the Code?

Reply: Annealed alpha aluminum bronze alloy, of composition as noted above, and conforming to ASTM B-169-49T Alloy D, may be used in the construction of unfired pressure vessels in accordance with Section VIII of the Code with the following limitations:

(1) *Corrosion Resistance*

(a) It is expected that vessels of alpha aluminum bronze covered by these rules will be used to hold corrosive liquids and gases. However, the selection of this alloy as being suitable in a specific application shall be the responsibility of the user.

(b) The determination of corrosion allowances is not covered by these rules. It is recommended that users assure themselves by appropriate tests, or otherwise, that the alloy is suitable for the service intended.

(c) Where service data are not available, the procedure of Par. UA-159 should be followed.

(2) *Design*

(a) The maximum allowable design stresses shall be as follows:

TABLE 1

Temp Subzero to	Allowable Working Stress for Sheet & Plate	Allowable Working Stress for Bolting Mtls.
150 F	17000 psi ($^1/_4$ t.s.)	6000 psi ($^1/_4$ y.s.)
200	16800 psi ($^1/_4$ t.s.)	5900 psi ($^1/_4$ y.s.)
300	14800 psi (0.8 creep)	5800 psi ($^1/_4$ y.s.)
400	11500 psi (0.8 creep)	5600 psi ($^1/_4$ y.s.)
500	8000 psi (0.8 creep)	5500 psi ($^1/_4$ y.s.)

(b) Since this alloy will be used for handling or storing corrosive fluids, care should be exercised to see that the design considers corrosion problems. All crevices where accelerated local attack may occur should be filled or sealed by fusion welding. These crevices usually are found behind backing strips, lap joints, and riveted joints.

(c) The outer fibers in the weld metal bend tests shall have a 20 per cent minimum elongation. This value is also the minimum requirement for the all-weld-metal tension-test specimen as noted in Section IX of the Code.

(d) No low-temperature impact tests are required for this material or for any deposited weld metal, if the composition is within the range of composition of the specifications. If the deposited weld metal does not meet this requirement, impact tests of the weld metal shall be made in accordance with the requirements of Par. UG-84. If the impact specimen bends without fracture, it shall be considered to have met the requirements.

(e) Stress-relieving is not required.

CASE NO. 1171

(Special Ruling)

Inquiry: Several of the grades of low-alloy steels in Specification SA-335 have limitations on the maximum phosphorus and sulphur content which can be met on steel made in the electric furnace but which may be slightly exceeded when these steels are produced in the open hearth. Will it be permissible to accept a maximum phosphorus and sulphur content increased to 0.04 per cent on check analysis where this would be permissible for the comparable grade in Specification SA-182?

Reply: It is the opinion of the Committee that Grades P3a, P3b, P11, P15, P21, and P22 may be furnished with maximum phosphorus and sulphur content of 0.04 per cent on check analysis when

these steels will be melted in the open-hearth furnace.

CASE No. 1172

(Special Ruling)

Inquiry: May nonpressure parts used only for extending (increasing) the heat-absorbing surface be attached to carbon steel tubing applying to Specification SA-178 by fusion welding, either continuous or intermittent, without stress-relief as now allowed for other tubing in Par. P-186(c)?

Reply: Nonpressure parts used only for extending (increasing) the heat-absorbing surface may be attached to carbon steel and carbon molybdenum tubes by fusion or resistance welding, either continuous or intermittent, without stress relief.

CASE No. 1174

(Special Ruling)

Inquiry: Will unfired pressure vessels fabricated by fusion welding under the applicable rules of Section VIII, 1952 Edition, meet the intent of the Code if the base material is an aluminum-magnesium-chromium alloy having the following composition (Alloy GR40A, Specification SB-178):

Magnesium, per cent	3.1 to 3.9
Chromium, per cent	0.15 to 0.35
Copper, max, per cent	0.10
Manganese, max, per cent	0.10
Zinc, max, per cent	0.20
Iron plus silicon, max, per cent	0.45
Other, each, max, per cent	0.05
Other, total, max, per cent	0.15
Aluminum	remainder

Reply: It is the opinion of the Committee that the aluminum-magnesium-chromium alloy described in the Inquiry may be used for the construction of unfired pressure vessels according to the applicable rules of Section VIII, 1952 Edition, subject to the following conditions:

(1) The mechanical properties of the material are not less than the following:

Condition	Tensile Strength, psi	Yield Strength, psi (0.2 per cent off-set)	Elongation in 2 in., per cent
Annealed	30000	11000	18
H112	30000	11000	8
H32	36000	26000	8
H34	39000	29000	6

(2) Sheet and plate further meet the applicable requirements of Specification SB-178.

(3) Rod, bar, and shapes further meet the applicable requirements of Specification SB-273.

(4) Pipe and tube further meet the applicable requirements of Specification SB-274.

(5) Fabrication is by fusion welding using filler metal complying in composition with the base material.

(6) The welding requirements and applicable paragraphs of Section IX, 1952 Edition, apply except that the tensile strength of the reduced-section tensile specimens shall be not less than 30,000 psi.

(7) The following maximum allowable stress values are used in applying the design rules where reference is made to Table UNF-23:

Condition	Metal Temperature Not Exceeding, Deg F						
	100	150	200	250	300	350	400
Annealed / H112	7350	7350	7350	7000	6400	5650	4900
H32	9000	8950	8850	8250	7400	6500	5600
H34	9750	9700	9500	8800	7900	6900	5900

(8) For welded joints, the allowable stress values for annealed material are used.

(9) In view of the fact that this alloy does not undergo a marked drop in impact resistance at low temperatures, no additional requirements are specified for temperatures down to —325 F (see Par. UNF-65).

(10) The joint efficiency factors, inspection, and testing comply with the applicable paragraphs of Section VIII, 1952 Edition.

(11) Thermal stress relieving is not mandatory.

(12) Bolting materials conform to an aluminum alloy listed in Table UNF-23 or of one of the grades of austenitic steel of Specification SA-193. These bolting materials shall not be welded. The allowable stress values in Table UNF-23 or UHA-23 shall apply.

(13) In addition to the material described herein, any of the aluminum alloy materials for which allowable stress values for welded construction are given in Table UNF-23 may be used for appurtenances and other attachments. These parts and their connections shall be designed in accordance with the lower of the stress values in Par. (7) above and the applicable values in Table UNF-23. The welding process for these connections shall be qualified in accordance with the applicable rules of Section IX, 1952 Edition, except that the strength of the reduced-section tensile specimen shall be not less than the lower of the specified tensile strength of the two materials in the annealed temper.

CASE No. 1176

(Special Ruling)

Inquiry: May the welding-qualification rules for nonferrous materials adopted as Part B of Section IX and published by reference in the December, 1953, issue of MECHANICAL ENGINEERING be used in construction under the Code?

Reply: It is the opinion of the Committee that Part B of Section IX dealing with welding qualifications for nonferrous materials, which has been approved, can be used in Code construction.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers, 1952

PAR. P-101(3) Revise definition of "Throat" to conform to the American Welding Society definition which reads "The distance from the root to the face of the weld."

PAR. P-298 Revise this paragraph to read:

Each boiler shall be provided with a valve connection at least 1/4 inch pipe size for the exclusive purpose . . . . . .

Material Specifications, 1949

EDITORIAL NOTE

The Boiler Code Committee has approved the following revisions to specifications to be included in Section II:

SA-30-52aT
SA-107-52aT
SA-157-50T
SA-158-51T
SA-193-52T
SA-203-52aT
SA-204-52aT
SA-206-51T
SA-212-52aT
SA-261-47
SA-280-51T
SA-299-52aT
SA-301-52aT
SA-302-52aT
SA-315-51T
SB-26-52T
SB-62-52
SB-75-52
SB-108-52T
SB-111-52
SB-149-52
SB-152-52
SB-178-52T
SB-273-52T

The Boiler Code Committee has recently voted to retract approval of Specifications SA-155-52aT Spec. for Electric-Fusion-Welded Steel Pipe for High-Temperature Service and SA-339-51T Spec. for Nodular Iron Castings which were published as approved in the September, 1952, MECHANICAL ENGINEERING.

The following specifications are no longer used, and should be deleted, because they are covered by recently adopted specifications as given: SB-210 (now covered by SB-274); SB-211 (now covered by SB-273); SB-221 (now covered by SB-273); SB-235 (now covered by SB-274); and SB-241 (now covered by SB-274).

Unfired Pressure Vessels, 1952

PAR. UHA-11(b) Re-letter this paragraph (d) and add the following paragraph (b):

(b) When the desired type of approved stainless steel is lacking in the specification covering the applicable form (tubing, casting, etc.) the material may be furnished to the general requirements of an approved specification with the chemical and mechanical properties conforming to those shown in another approved specification for the desired grade.

Announcement

Part B, *Qualification Standard for Welding Procedures, Welders, and Welding Operators*, Section IX, for Nonferrous Materials, has been approved and is available from the Society. The present 1952 Section IX covers ferrous material only; an Addenda will be issued to bring it up to date.

A 1953 edition of Section IX will be published shortly and will contain Part A, Ferrous Material, and Part B, Nonferrous Material.

Welding Qualifications, 1952

TABLE Q-11.1 Add the following specifications. Asterisks (*) indicate specifications already listed which have been revised.

Specification	Grade	Psi min Tensile	Type of Material
P-NUMBER 1			
SA-7		60–72000	Carbon Steel Plates
SA-113	C	48–58000	Carbon Steel Plates
SA-333	C	55000	Carbon Steel Pipe for Low-Temp. Service
SA-334	C	55000	Carbon Steel Tubes for Low-Temp. Service
*SA-216	WCA	60000	Carbon Steel Castings
*	WCB	70000	Carbon Steel Castings
P-NUMBER 3			
SA-335	P1	55000	C-Mo Pipe
	P15	60000	S1-Mo Pipe (1.40 Si-0.55 Mo)
P-NUMBER 4			
*SA-301	A	65–82000	Cr-Mo Steel Plates (0.60 Cr-0.50 Mo)
*SA-301	B	60–77000	Cr-Mo Steel Plates (0.95 Cr-0.50 Mo)
SA-335	P2	55000	Cr-Mo Pipe (0.60 Cr-0.85 Mo)
	P3a	60000	Cr-Mo Pipe (1.75 Cr-0.70 Mo)
	P3b	60000	Cr-Mo Pipe (2.00 Cr-0.55 Mo)
	P11	60000	Cr-Mo Pipe (1.25 Cr-0.55 Mo-Si)
	P12	60000	Cr-Mo Pipe (0.95 Cr-0.55 Mo)
SA-182	F11	70000	Cr-Mo Pipe Flanges (1.25 Cr-0.55 Mo)
SA-336	F2	70000	Cr-Mo Drum Forgings (0.95 Cr-0.55 Mo)
P-NUMBER 5			
SA-213	T7	60000	Cr-Mo Steel Tubes (7.0 Cr-0.50 Mo)
	T9	60000	Cr-Mo Steel Tubes (9.0 Cr-1.0 Mo)
SA-333	3	65000	Ni-Steel Pipe (3.50 Ni) for Low-Temp. Service
	5	65000	Ni-Steel Pipe (5.00 Ni) for Low-Temp. Service
SA-334	3	65000	Ni-Steel Tubes (3.50 Ni) for Low-Temp. Service
	5	65000	Ni-Steel Tubes (5.00 Ni) for Low-Temp. Service
SA-335	P5a	60000	Cr-Mo Pipe (5.00 Cr-0.50 Mo)
	P5b	60000	Cr-Mo Pipe (5.00 Cr-0.50 Mo)
	P5c	60000	Cr-Mo Pipe (5.00 Cr-0.50 Mo-Ti)
	P16	60000	Cr-Mo Pipe (7 Cr-0.55 Mo)
	P17	60000	Cr-Mo Pipe (9 Cr-1.00 Mo)
	P21	60000	Cr-Mo Pipe (3 Cr-0.90 Mo)
	P22	60000	Cr-Mo Pipe (2.25 Cr-1.0 Mo)
SA-336	F5	80000	Cr-Mo Drum Forgings (5.0 Cr-0.55 Mo)
	F22	80000	Cr-Mo Drum Forgings (2.25 Cr-1.00 Mo)
SA-217	C5	70000	Cr-Mo Castings (5.0 Cr-0.55 Mo)
	C12	70000	Cr-Mo Castings (9.0 Cr-1.0 Mo)
SA-357		60000	Cr-Mo Plate (5.00 Cr.-$^1/_2$ Mo)
P-NUMBER 6			
SA-336	F6	75000	Alloy Forgings (13 Cr)
SA-351	CA15	90000	Alloy Castings (13 Cr-0.5 Mo)
P-NUMBER 8			
SA-213	TP310	75000	Alloy Tubes (25 Cr-20 Ni)
SA-312	TP304	75000	Alloy Pipe (18 Cr-8 Ni)
	TP309	75000	Alloy Pipe (25 Cr-12 Ni)
	TP310	75000	Alloy Pipe (25 Cr-20 Ni)
	TP321	75000	Alloy Pipe (18 Cr-8 Ni-Ti)
	TP347	75000	Alloy Pipe (18 Cr-8 Ni-Cb)
	TP316	75000	Alloy Pipe (16 Cr-13 Ni-3 Mo)
	TP317	75000	Alloy Pipe (18 Cr-13 Ni-4 Mo)
SA-249	TP310	75000	Alloy Tubes (25 Cr-20 Ni)
SA-336	F8	75000	Alloy Forgings (18 Cr-8 Ni)
	F8t	75000	Alloy Forgings (18 Cr-8 Ni-Ti)
	F8c	75000	Alloy Forgings (18 Cr-8 Ni-Cb)
	F8m	75000	Alloy Forgings (18 Cr-8 Ni-Mo)
	F25	95000	Alloy Forgings (25 Cr-20 Ni)
SA-351	CF8	70000	Alloy Castings (18 Cr-8 Ni)
	CF8M	70000	Alloy Castings (18 Cr-9 Ni-2.5 Mo)
	CF8C	70000	Alloy Castings (18 Cr-9 Ni-Cb)
	CH20	70000	Alloy Castings (25 Cr-13 Ni)
	CK20	65000	Alloy Castings (25 Cr-20 Ni)

ASME NEWS

With Notes on the Engineering Profession

ASME International Meeting Prospects Enhanced by Tour of Mexico

Headquarters: Del Prado, Mexico, D. F., March 10–12

PALACE OF FINE ARTS, ONE OF THE HIGH SPOTS TO BE VISITED DURING THE ASME INTERNATIONAL MEETING TO BE HELD IN MEXICO, D. F., MARCH 10–12

THE plans being currently arranged for the 10-day trip, March 8–17, to Mexico and visits to various famous cities in Mexico promise to enhance the prospects of the 1954 ASME International Meeting to be held at the Hotel Del Prado in Mexico, D. F., March 10–12, 1954.

The itinerary offers an excellent opportunity to see the most of fabulous Mexico in a short time. However, for those who are planning to take the trip and have more time to devote, additional side trips can be supplemented.

As the tour shapes up now, here is what is in store for the participants. From various points in the United States to Mexico City, go via American Airlines deluxe DC-6 Flagship, arriving March 8, and transfer to the Hotel Del Prado. This is a beautiful new hotel ideally situated right on the Avenida Juarez in the heart of the shopping district, a stone's throw from the Palace of Fine Arts, and many other exciting places to see.

Taxco and Cuernavaca

The next day, Tuesday, March 9, sightseeing will include Taxco and Cuernavaca. The group will leave Mexico City for a scenic drive to Cuernavaca, the enchanting resort town that has been the favorite alike of Cortez, Maximilian, and today's well-to-do Mexicans. There the visitors will see the Borda Gardens, Mexico's Versailles, and the Palace of Cortez, where Diego Rivera's murals depict the story of the coming of the Spaniards. Continue by motor to the quaint village of Taxco, which is noted for its mines and silver shops perched along picturesque and hilly streets. The majesty of the Borda Cathedral is evident from every direction in Taxco. Spend the night in this charming village. The next morning will be devoted to visiting the many interesting silver shops, the Casa Figueroa, and the Cathedral of Santa Prisca, returning to Mexico in the early evening.

Mexico City

The next day the ASME meetings will be in session in the morning so that sightseeing will not begin until the afternoon when an interesting drive through Mexico City is planned. To be seen on this trip will be the Zocalo, the main public square; the Cathedral of St. Peter, the most ancient church in America; Chapultepec Castle, where Maximilian and Carlotta lived and received royalty; the Palace of Fine Arts; the National Theater; the National Museum; the Ministry of Education. The walls of the patio are covered with heroic frescoes by Diego Rivera; the colorful markets; the residential district; and many other points of interest.

On the following day, after the regular sessions of the meeting are concluded, the tour goes to the Shrine of Guadalupe and the Pyramids of the Sun and the Moon, ancient altars of worship of the Toltec and Aztec tribes. Proceeding through the Temple of Quetzalcoatl, the group will view the beautiful carvings of the ancient Indians. The afternoon excursion on Saturday has been arranged to include technological points of interest.

A Mexican Sunday

Sunday—a lovely Mexican Sunday is scheduled. In the morning the party will visit Xochimilco, the "floating gardens." These are a series of lagoons dotted with hundreds of tiny islands covered with flowers, trees, and profuse tropical vegetation. Enjoy a cruise along the picturesque canals in a flower-bedecked boat surrounded by the fragrant flowers and the soft music of this Mexican Venice—the comparison is limited to the waterway. The party will return to Mexico

City in time to witness the most colorful event of the Continent—the Bullfight! In the largest bull ring in the world, at 4:00 p.m. sharp (it is said to be the only thing starting on time in all of Mexico), every Sunday you can see the glory and splendor of the "fiesta de tores."

Acāpulco

Bright and early Monday morning the party will be off by air for the tropical paradise of Acapulco—it has been compared to Amalfi. See it and draw your own conclusions. The headquarter hotels here will be Prado Americas and Club de Pesca. Against a background of the Sierra Madre Mountains in a Hawaiian-like setting, you will find the smart gaiety of the French Riviera. Swim in the warm Pacific in protected coves or splash in the pounding surf—tan out in the warm white sands, or try your luck on the briny deep where marlin and sailfish abound. It will be difficult, but on Wednesday you will have to leave for Mexico City to make connection with the night flight back to the United States.

Some of the place names are tongue twisters, but it is certainly worth learning every one of them. A wonderful trip awaits every one who goes. The cost for the round trip from New York, N. Y., subject to Family Plan of one fare and half fare, for man and wife, first class, including taxes is $501.66; Air Tourist, each person, round trip, $273.24. Write ASME Secretary if interested.

SUNDAY AFTERNOON AT THE BULLFIGHTS

TWIN TOWERS OF THE CHURCH OF SANTA PRISCA, TAXCO

F. S. Mallette Chosen to Give Clayton Lecture

FREDERICK S. MALLETTE, executive secretary of the Committee on Air Pollution Controls and staff member of The American Society of Mechanical Engineers, has been invited to give a Clayton Lecture on air pollution before The Institution of Mechanical Engineers of Great Britain in London England, on April 23, 1954, it was announced by Frederick S. Blackall, jr., president of the Society.

The Clayton Lecture was instituted in 1944 under a bequest from the late James Clayton, to promote the advancement of knowledge in any field relating to mechanical engineering.

Interest in air pollution in Great Britain has been greatly stimulated by the severe smog of December, 1952, to which over 4000 deaths were attributed in London alone. The British Government subsequently appointed a committee of distinguished scientists to study the problems associated with fog and air pollution problems.

In commenting on the invitation to Mr. Mallette, considered a singular honor among engineering groups, Gerald V. Williamson, superintendent of steam engineering at the Union Electric Company of Missouri, St. Louis, Mo., who heads the ASME's Committee on Air Pollution Controls, stated, "The intensive activities carried on by the Committee in this country and the results of our recent report on air-pollution research in over 40 universities, research institutes, and laboratories can be drawn upon by Mr. Mallette in presenting American experience as an aid to the solution of this problem in Great Britain."

The President's Page

The Opportunity of a Lifetime— A Great Engineering Center

ONE of the pressing problems which face the four Founder Societies is that of finding new headquarters. The present Engineering Societies Building in West 39th Street, New York, was completed in 1906. While it has served its purpose admirably over the years, the space available is far from adequate today to house the administrative staffs required to serve 142,000 members within the four Societies. This membership has grown nearly tenfold since the structure was built. Furthermore, the facilities in many respects have become obsolete or are in imminent need of costly repairs or reconstruction. The United Engineering Trustees, who own and operate the building in behalf of the four Societies, are studying the matter actively. Among the considerations which confront them are optimum location, requisite area, nature of facilities, and, of course, the question of financing. The latter presents some problems in these days of high building costs, but thanks to depreciation accruals, other reserves, the potential return from the sale of the present building, and the availability of credit, they are by no means insurmountable.

In brief, present circumstances offer literally the opportunity of a lifetime for the Founders to co-operate with other leading professional groups in establishing a new and great engineering center, where *all* of the leading engineering societies of our nation could make their national headquarters in one place. Of course a prerequisite to such a project would be that of securing within a short space of time the agreement of all, or most of, the other societies to participate on an equitable basis. On the other hand, the prospect ought to be as attractive to them as it appears to us.

There are indications that one or another of the large real estate operators in New York or elsewhere might jump at the chance to devise architectural and financial plans for such a venture. These might go beyond immediate administrative needs, if tax exemptions would permit, to provide a building which would accommodate not only the staffs of the societies, but a substantial number of tenants of acceptable character as well, whose interests lie in related fields. Rentals would assist in carrying the building overhead. Properly located, such a center might well attract satellite buildings to the neighborhood to be erected by industrial and commercial interests allied with the engineering fields. A new Engineers' Club would be an appropriate tenant of such an engineering center.

The interesting potentials of this dream have not been overlooked by civic boosters and planners in cities outside of New York. Pittsburgh, Detroit, Chicago, Baltimore, and Washington, all have expressed interest in undertaking the project and specific proposals have been received from some of them. Certain difficult legal obstacles might constitute a barrier to any move away from New York, since the endowment of Andrew Carnegie under which the Engineering Societies Building was built and operates in part, stipulates that the funds are to be employed for an engineering headquarters "within the city of New York." The question of geographic site brings into play other considerations, many of which favor retention of the present location anyway, although some might favor a move. The membership may be assured that the Trustees will weigh all of the pros and cons before reaching any decision on this point.

But whatever is done, it is earnestly to be hoped that the utmost effort will be exerted to make our Society's new home a great engineering center in which all of the major professional societies can work together in the closest possible proximity. Such an accomplishment would be one more step in the direction of unity of the engineering professions through intersociety co-operation. As your president has observed before on this page, this, in his judgment, is the most effective manner in which real unity of thought and action can be achieved.

A great opportunity is at hand. Let us make the most of it.

FREDERICK S. BLACKALL, JR., *President*
The American Society of Mechanical Engineers

Second Engineering Management Conference Plans Announced

THE problems facing engineering management concerned with sales and product research will receive considerable attention from the speakers at the second Engineering Management Conference sponsored by the Management Division of The American Society of Mechanical Engineers, to be held at the Benjamin Franklin Hotel in Philadelphia, Pa., March 31–April 1, 1954. The Management Division, with the active co-operation of the ASME Philadelphia Section, is planning the conference to anticipate the needs of engineering executives and engineers, preparing for management responsibilities, and for suggestions in handling the problems placed upon the engineering management by a dynamic economy.

Scope of Program

The program for the second Engineering Management Conference was developed from the suggestions contained in the questionnaires which were sent to the 440 engineering executives who attended the first Conference which was held April, 1953, in Detroit, Mich. More than 200 of the questionnaires have been returned and are being carefully studied by the Executive Committee of the Management Division to determine the preferences of a broad cross section of ASME members and of nonmembers concerned with improving the effectiveness of engineering management.

In addition to technical sessions devoted to the administration of sales-engineering and product-development activities, there will be sessions devoted to the broad national problems facing top-level engineering management, to topics of interest to engineers generally as professional individuals, and to techniques for improving engineering supervision. The sessions are being scheduled to permit ample time at the session for discussion. The luncheons will be informal to give the conference members the opportunity to further discuss these important topics. The papers to be presented at the meetings will be preprinted and distributed prior to the conference to encourage more active participation in the discussion by the audience.

The tentative topic program for the Conference includes the following:

Wednesday morning, March 31, 1954

National Policy and Its Effect Upon Engineering Management
Engineering Management's Responsibilities in a Developing Economy

Wednesday afternoon, March 31, 1954

What Makes Engineers Die Young?
How to Sell Ideas Effectively
Progress Toward a Unity Organization for the Engineering Profession

Thursday morning, April 1, 1954

Session A—Sales-Engineering Management
Trends in National Consumption and Their Effect Upon Engineering Sales Management
How to Manage an Engineering Sales Department
How to Select and Train Technical Sales Personnel

Session B—Product Research and Development
How to Organize and Select Engineering Projects
Progress and Cost Control in Engineering Projects
Effective Utilization of Manpower in Research and Development

Thursday afternoon April 1, 1954

Executive-Development Program for Engineers
Incentives for Engineers
Executive Co-Ordination of Engineering Activities

Many Prominent Speakers

Some of the prominent men who have already accepted invitations to participate in the second Engineering Management Conference program include Hector R. Skifter, president of Airborne Instruments Laboratories; James F. Lincoln, president of Lincoln Electric Company; T. A. Marshall, Jr., executive secretary of Engineers Joint Council; Phil Carroll, management consultant; and Trafford W. Bigger, development engineer, General Electric Company. Arrangements are in progress to invite a leading official in the national government to discuss the impact of national policy upon engineering management. Similarly qualified speakers are being selected to discuss the remaining topics on the program. The final program will be presented in the near future.

The program is being patterned after the first Engineering Management Conference which received many favorable comments, including the one from Frederick S. Blackall, jr., ASME President, which was published on The President's Page in the September, 1953, issue of MECHANICAL ENGINEERING. The purpose of this series of conferences is to present the latest and the most productive thinking concerning the problems facing engineering management. The engineering skills of America are among its greatest resources. Effective engineering management will produce significant contributions to a constantly improving standard of living in this country which could be reflected throughout the world.

Professional Divisions' Executive Conference to Be Held Jan. 7–8, 1954

AN innovation for the indoctrination of personnel associated with Professional Divisions' activities is planned for January 7–8. A group of 60 to 70 people will assemble at the Knolls at Schenectady, N. Y., as guests of the General Electric Company, to learn about the relationship of Society activities.

The morning session, January 7, will consider such topics as Divisions, Publications, and Research, presented in paper form, with time allowed for discussion. The afternoon will be assigned to the inspection of the General Electric Laboratory and factory operations.

The adequacy of present division structure and Section-Divisions' co-operation will be the questions covered in the morning session on January 8. The afternoon session has been designed to provide an excellent opportunity to summarize and conduct a forum to answer the questions that may arise. It is hoped that a lively discussion will develop into concrete suggestions tending to improve Society operations.

ASME Membership as of Oct. 31, 1953

Honorary Members	52
Fellows	379
Members	13,918
Associates	335
Juniors (33 and over)	3,343
Juniors (30–32)	1,985
Juniors (to the age of 29)	18,778
Total	38,790

Modern Scientific Management Looms as World Leader

THROUGH the application of modern scientific-management methods, it is now possible to offset great and costly damage by recognizing and almost immediately correcting serious defects in industry, education, government, and labor. This would not have been possible in past decades due to outmoded managerial techniques," it was told jointly to members of the Greater New York Chapter of the American Society of Tool Engineers and the New York Tool and Die Institute at their annual dinner held October 5.

In addressing the Technical Societies, Carl E. Nagel, vice-president and managing director of the Council for International Progress in Management, said that the dawn of a new management era is here. He declared that there has never been a time in history when American management men have borne greater responsibilities. "And yet," he added, "management at the same time is planning to do much more to make even greater opportunities available in the future for every man, woman, and child in the United States as well as in the free nations throughout the world."

Mr. Nagel stated that it is the social responsibility of leader groups such as the ASTE and the Tool and Die Institute, both of whom are representative of industry, to become cognizant of and to help in spreading the new scientific-management doctrine. "For the first time since the Korean War," he stated, "it is now possible for industry in this country to take many more concrete steps in the development planning of products and methods. Restrictions on the use of many production materials have been raised and purchasing agents can now buy basic materials in quantities sufficient to use in expanded production. "Indeed," the management specialist declared, "reports now current from key industries show that a significant wave of new-product development is under way."

He cited the importance of the international aspects of management and strongly advocated the continuance of American and foreign authorities exchanging managerial know-how toward the end of standardizing modern management thinking. He then predicted that a strong impact would be felt at the international management level as a result of the Tenth International Management Congress scheduled to be held in Sao Paulo, Brazil, in early 1954, when eight management subjects will be discussed.

In concluding, Mr. Nagel stated that it would be axiomatic that better management in government, business, and labor will in turn provide a better opportunity for business, wages for labor, lower prices, more value for consumers, and a better standard of living for all.

People

Eleven Americans and a Swiss scientist were honored Oct. 21, 1953, at the annual Medal Day ceremony of The Franklin Institute of the State of Pennsylvania held in the Institute's lecture hall. The award ceremony followed a reception and dinner attended by several hundred scientists in varied fields.

The Franklin Medal, the Institute's highest award, went to WILLIAM FRANCIS GIBBS, Fellow ASME, naval architect and marine engineer of New York, N. Y., who spoke about the liner *United States*, the accomplishment for which he was honored. Mr. Gibbs is president of Gibbs & Cox.

Other awards went to: ADOLPH MEYER, Life Mem. ASME, Calvin W. Rice Lecturer, chairman of the board of the Brown, Boveri Company, Baden, Switzerland, the George R. Henderson Medal. GEORGE R. HARRISON, dean of science at the Massachusetts Institute of Technology; WILLIAM F. MEGGERS, chief of the spectroscopy section of the National Bureau of Standards; and WILLIAM BLUM, former chief of the electrodeposition section of NBS, each received an Elliott Cresson Medal. S. DONALD STOOKEY and ROBERT H. DALTON, research chemists at the Corning (N. Y.) Glass Works, were awarded John Price Wetherill Medals. CHESTER F. CARLSON, Fairport, N. Y., attorney and physicist, was given the Edward Longstreth Medal. The Lewis E. Levy medal went to GEORGE C. NEWTON, JR., associate director of M.I.T.'S Servomechanisms Laboratory. FRANK L. WRIGHT received the Frank P. Brown Medal for his "contributions to the entire field of architecture." ROBERT F. MEHL, director of the Metals Research Laboratories at the Carnegie Institute of Technology, was presented with the Francis J. Clamer Medal; and to DAVID G. C. LUCK of the David Sarnoff Research Center of the Radio Corporation of America, went the Stuart Ballantine Medal.

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The selection of CHARLES AUGUSTUS LINDBERGH as the recipient of the Daniel Guggenheim Award for 1953 has been announced jointly by The American Society of Mechanical Engineers, the Society of Automotive Engineers, and the Institute of the Aeronautical Sciences. Presentation of the award will be made by Harry Guggenheim at the Honors Night Dinner of the Institute of the Aeronautical Sciences on Jan. 25, 1954, at the Hotel Astor, New York, N. Y.

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WILLIAM EMBRY WRATHER, past-president of the American Institute of Mining and Metallurgical Engineers and director of the U. S. Geological Survey, has been named the 1954 recipient of the John Fritz Medal.

* * *

A. H. BURR, Mem. ASME, and C. O. MACKEY of the college of engineering at Cornell University, have been appointed to endowed professorships. Both are in the Sibley School of Mechanical Engineering. Professor Burr, head of the department of machine design, has been named Hiram Sibley Professor, and Professor Mackey, head of the department of heat-power engineering, John Edson Sweet Professor of Engineering. Friends and former students of the late Professor Sweet, one of the Founders of ASME, and members of the Society established the professorship in 1927.

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GEORGE GERARD, Jun. ASME, has been appointed assistant director of the Research Division of New York University's college of engineering. He is executive secretary of the ASME Aviation Division.

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JOSEPH MARIN, Mem. ASME, professor of engineering mechanics and research professor of engineering materials, has recently been made head of the department of engineering mechanics at The Pennsylvania State College.

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STEPHEN I. JUHASZ has been appointed executive editor of *Applied Mechanics Reviews*, which is published by ASME. Dr. Juhasz, born in Budapest, Hungary, is a graduate of the Royal Institute of Technology, Budapest, and is a postgraduate of the Royal Institute of Technology, Stockholm, Sweden. He comes to Midwest Research Institute, where the magazine is edited, from the Massachusetts Institute of Technology Fuels Research Laboratory.

ROBERT H. HOSE, MEM. ASME, WAS ELECTED PRESIDENT OF THE SOCIETY OF INDUSTRIAL DESIGNERS DURING THE EIGHTH S.I.D. ANNUAL DESIGN CONFERENCE HELD AT BEDFORD, PA.

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FRANK L. SCHWARTZ, Mem. ASME, professor of mechanical engineering, University of Michigan, represented the Society at the inauguration of Clarence B. Hilberry as President of Wayne University, Nov. 9, 1953.

* * *

GEORGE SACHS, director of metallurgical research at Syracuse University, received the gold medal award at the American Society for Metals annual meeting held in Cleveland, Ohio, Oct. 19-23. HILAND G. BATCHELLER, chairman of the board of Allegheny-Ludlum Steel Corporation, Pittsburgh, Pa., was awarded the research medal. The ASM Campbell Memorial lecturer certificate for 1953 went to DONALD S. CLARK, Mem. ASME, professor of mechanical drawing, California Institute of Technology. Dr. Clark has been the recipient of two awards from the American Society for Testing Materials—the Richard L. Templeton award in 1949; Charles B. Dudley medal, 1951.

* * *

VANNEVAR BUSH, 1953 ASME Holley Medalist, president of Carnegie Institution of Washington, was honored as the second recipient of the American Institute of Consulting Engineers award of merit in the 43-year history of the Institute, at the annual dinner held Oct. 19, 1953, at the Hotel Statler, New York, N. Y.

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MERVIN J. KELLY, president of Bell Telephone Laboratories, Murray Hill, N. J., was named to receive the Industrial Research Institute Medal for 1954. Official presentation of the medal will be made at an Institute dinner to be held on April 22, 1954, in San Francisco, Calif.

* * *

FRED L. PLUMMER, Mem. ASME, director of engineering, Hammond Iron Works, Warren, Pa., has been re-elected president of the American Welding Society for 1953-1954. Other national officers elected included: J. H. HUMBERSTONE, vice-president, Air Reduction Company, Inc., first vice-president; J. J. CHYLE, director, welding research, A. O. Smith Corp., second vice-president; and RUSSELL S. DONALD, president, R. S. Donald, Inc., who was elected to a third successive term as treasurer.

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WALTER H. WOODING, superintendent, metals section, Industrial Test Laboratory, Philadelphia Naval Shipyard, Philadelphia Naval Base, Pa., has been awarded the American Welding Society 1953 Lincoln Gold Medal for his paper entitled "The Inert-Gas Shielded-Metal Arc-Welding Process."

PAUL F. CHENEA, who came to Purdue University September, 1953, from the University of Michigan, to become professor of engineering mechanics and research professor of materials, was named as assistant dean of the five Purdue engineering schools.

* * *

ERIC L. ANDERSON, superintendent of the electrical department of Bethlehem Steel Company, Johnstown, Pa., was elected president for 1954 at the annual meeting of the Association of Iron and Steel Engineers held in Pittsburgh, Pa., September 29.

* * *

ODOM FANNING, former information officer of the U. S. Public Health Service Communicable Disease Center in Atlanta, Ga., has been appointed head of the Publications Services of the Georgia Institute of Technology Engineering Experiment Station.

University of Michigan Marks 100th Year of Engineering Instruction

Cooley Building Dedicated

DEDICATION of a new building named after the University of Michigan's first professor of mechanical engineering highlighted the two-day celebration of the 100th anniversary of engineering instruction in Ann Arbor, Mich., October 23–24.

Walker L. Cisler, Fellow ASME, and president of the Detroit Edison Company, dedicated the structure in honor of Mortimer E. Cooley, Hon. Mem. and president of The American Society of Mechanical Engineers, 1919, who became professor of mechanical engineering at the University of Michigan in 1881 and was dean of the College of Engineering from 1904 to 1928.

The Cooley Building will be used by the University's Engineering Research Institute which was established in 1920.

After reviewing the life and service of Mortimer E. Cooley, Mr. Cisler went on to describe hopes for the Dow-Edison and Associates Nuclear-Power Project, which has as its broad goal the establishment of a competitive atomic industry in the United States.

Honorary Degrees Conferred

Ten honorary Doctor of Engineering degrees were awarded at a convocation which opened the celebration. Some twenty-four citations were awarded to distinguished alumni in recognition of their outstanding achievements and contributions to the development of the field of engineering.

Those receiving degrees were Wyeth Allen, Mem. ASME, president of Globe-Union, Inc., Milwaukee, Wis.; Harold F. Robinson, chief naval architect of the Shipbuilding Division of the Bethlehem Steel Company, Boston, Mass.; Smith J. De France, director of the Ames Aeronautical Laboratory at Moffett Field, Calif.; Thomas D. Jolly, Fellow ASME, vice-president, chief engineer, and director of purchases of the Aluminum Company of America, Pittsburgh, Pa.; Lou R. Crandall, president of the George A. Fuller Company, New York, N. Y.; Harvey Milton Merker, director of scientific relations for Parke, Davis and Company, Detroit, Mich.; James W. Parker, past-president and Hon. Mem. ASME, former president and general manager of the Detroit Edison Company; Robert Moses, Commissioner of Parks, New York, N. Y.; Charles Erwin Wilson, Secretary of Defense, Washington, D. C.; and Alfred Holmes White, professor emeritus of chemical engineering, University of Michigan. Professor White's degree was awarded posthumously, as he died last August 25.

Six of the ten recipients are University of Michigan graduates. Messrs. Wilson and Jolly are graduates of Carnegie Institute of Technology, Mr. Parker is a Cornell alumnus, and Mr. Moses has degrees from Yale, Oxford, and Columbia Universities.

Secretary Wilson spoke at the convocation on the topic, "Continuing Frontiers." He reviewed the history of the past 100 years and concluded by saying:

"In place of the physical frontier that man explored centuries ago, we now have what might be called two continuing frontiers: one in the material and scientific field and the other in the political and human-rights field. Americans hope a broader and better understanding of the discoveries and developments in these two fields both at home and abroad will eventually bring peace and prosperity to the whole world."

Robert Moses Speaks at Banquet

At a banquet Friday night Robert Moses, Commissioner of Parks for New York City, speaking on "The Contributions of Modern Engineering to Our Civilization," gave these six "bits of advice to make the engineer more useful to society:"

1 To meet the demand for engineers, "corporations, and particularly those which have some logical relation to engineering, should contribute much more liberally—especially to endowments, laboratories, chairs, and scholarships—out of their earnings under the Federal five per cent exemption rule."

2 "I strongly urge broader education before specialization."

3 "I particularly urge upon technical colleges training in speaking and writing the English language. Engineering, to be sure, deals with facts, but even the language of fact must be understandable and may be eloquent."

4 "We must now narrow the gap between car production and road construction. The minimum time required to carry out an adequate program is ten years and fifty billion dollars of new construction is required." Governments of all levels must contribute funds through bond issues.

5 Engineers must joint together "to insist upon a logical plan which will combine and correlate engineering functions under competent professional leadership in one branch of the Federal Government."

6 "I respectfully ask whether the engineering profession . . . has concentrated sufficiently and applied enough of its resources in recent years in the solution of such practical problems as—harnessing the sun's rays and extracting salt from sea water. I do not even remotely charge that these subjects have been neglected. I merely suggest that they have not advanced from basic to applied research with anything like the speed which has accompanied the many recent inventions in the fields, let us say, of transmission of sound and sight."

At a convocation Saturday morning, speakers and their topics were: Harvey M. Merker, Director of Scientific Relations, Parke, Davis and Company, Detroit, Mich., "Centennial History"; George Granger Brown, dean of the college of engineering, "The College Today and Tomorrow"; and James W. Parker, "Engineering the Future."

Awards for Welded Designs

YOUNG mechanical and structural engineers in 16 states and three engineering schools have received national recognition through the James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. The Foundation has announced the 1953 awards for engineering-undergraduate papers on welded design of machines and structures. Forty-six cash awards ranging from $25 to $1250, and totaling $5000, were presented to 51 undergraduate engineers in 21 different engineering schools. Scholarship funds totaling $1250 were granted.

The first award of $1250 was given to co-authors, Clayton Wilkie and Henry Cohen, who, as undergraduates in the civil-engineering department of the New York University, prepared a paper describing the "Design for a Welded Continuous-Curved-Girder Highway Bridge." As additional recognition, the Foundation presented the New York University with $1000 to be used for scholarships named in honor of these students.

Thomas J. Feaheny, Jr., described the "Design of Material-Handling Containers for a Forge Shop" and received the second award of $1000. The mechanical-engineering department of the University of Detroit received $500 in scholarship funds honoring this achievement.

William J. Chancellor, as an agricultural-engineering student at the University of Wisconsin, received the $500 third award. He described the "Design and Construction of a Chain Mower." The University of Wisconsin received $250 for a scholarship in his honor.

The purpose of these awards is to encourage engineering students to study how machines and structures made of steel can be improved and reduced in cost by the application of arc welding in their design. Awards are made annually for the best papers describing the use of arc welding in the design of a machine or structure. All engineering undergraduates are eligible to participate. The rules for participating in the 1953–1954 Program are available from the James F. Lincoln Arc Welding Foundation, Cleveland 17, Ohio.

ASEE and ECPD Hold Joint Meeting in New York

SUCCESS of the joint meeting of the American Society for Engineering Education and the Engineers' Council for Professional Development, held at Chicago, Ill., in September, 1952, in connection with the Centennial of Engineering, prompted decision to hold another joint meeting at the Hotel Statler, New York, N. Y., Oct. 14-17, 1953.

The ASEE program began on Wednesday, October 14, with a meeting of the ASEE Executive Board, chairmen of ASEE Divisions, and members of the General Council of ASEE, held in the Engineering Societies Building. At noon, the executive committee of the Engineering College Research Council met at luncheon at The Engineers' Club, Dean Eric Walker presiding. In the afternoon there was a meeting of the General Council, ASEE, in the Engineering Societies Building, with L. E. Grinter, president ASEE, presiding. This was followed by a dinner and general meeting at The Engineers' Club. On Thursday evening, October 15, the executive committee o the Engineering College Administrative Council (ASEE) held a dinner meeting at the Hotel Statler, with W. L. Everitt presiding.

Sessions on Creativeness

Two sessions of a conference, one devoted to creativeness in the arts and the other to creativeness in engineering, were held at the Hotel Statler on Thursday morning and afternoon. These sessions were sponsored by the Engineering College Research Council and Engineering College Administrative Council and were open to all members and representatives of ASEE and ECPD and to the general public. The sessions were enthusiastically received and provoked considerable discussion.

At the morning session, Eric A. Walker, vice-president ASEE, and dean of engineering, The Pennsylvania State College, presided. The theme, Creativeness in the Arts, was developed by three speakers: Virgil Thompson, music critic, New York *Herald Tribune;* John Ferren, internationally famous painter; and Ralph Bates, Department of Literature, New York University.

W. L. Everitt, vice-president ASEE, and dean of engineering, University of Illinois, presided at the afternoon session where the theme, Creativeness in Engineering, was developed by Fred Olsen, vice-president for research and development, Olin Industries, who presented the industrialist's point of view, and Maurice Nelles, director, Borg-Warner Laboratory, the engineering point of view.

At the luncheon, with L. E. Grinter, president ASEE, and dean of engineering and director of research, University of Florida, presiding, Morris I. Stein, professor of psychology, University of Chicago, spoke on the subject, "A Psychologist Looks at Creativeness, Its Environment, and Its Measurement."

Accrediting and Evaluation

At a session on Friday morning, with Dean Thorndike Saville, chairman ECPD Education Committee and dean of engineering, New York University, presiding, various phases of accreditation and evaluation of engineering education were discussed. A summary of this discussion is reported elsewhere in this issue (pages 1037-1039).

General McNaughton Discusses Water Problems

Despite large hydroelectric resources and recent power developments, Canada has no power surplus, Gen. A. G. L. McNaughton, chairman of the Canadian Section of the International Joint Commission, told the ASEE-ECPD luncheon group on Friday.

Presently foreseen expansions in the Canadian economy will employ all of Canada's available economical power, General McNaughton said. Future power developments in two important areas, he pointed out, are involved in Canadian negotiations with the United States. These are the St. Lawrence Seaway and Columbia River system.

Canada is hoping to begin power-works development along the St. Lawrence next spring, General McNaughton said. It seems to Canadians "that every conceivable argument against the St. Lawrence project has been answered," he declared. The issue of American association with the Ontario Hydro Electric Power Commission for construction of power works is still in the U. S. Courts, he said.

Turning to the Columbia River basin, General McNaughton reported "sharp differences" in hearings on the U. S. application to erect a dam at Libby, Mont. The project would produce about 1,000,000 hp at the site and would benefit industrial plants in both countries. While financial compensation can be negotiated for lands, rebuilding of roads, railways and communications, damaged forests and minerals, and resettlement of residents, major disagreement centers on the lands that will be flooded 42 miles over the border into Canada.

Downstream interests will settle only in terms of monetary compensation, while the flooded areas are asking for recompense in the form of increased power allocations, General McNaughton stated.

The use of the Watertown and Belly Rivers for irrigation in Alberta has also aroused a "sharp, determined, and long-enduring" controversy, General McNaughton said. The rivers rise in Montana and flow into Alberta. Their application to irrigation would transform a desert into productive farm land.

In contrast to the St. Lawrence, Columbia, and Montana-Alberta difficulties, he added, cases concerning the St. John River (between Maine and New Brunswick) and remedial work at Niagara Falls are being concluded in "the spirit of close co-operation and understanding of the points of view of those on both sides."

Col. L. F. Grant, chairman of the Engineers' Council for Professional Development, presided at the luncheon meeting.

Post-College Training

A community project to assist in the professional development of young engineers was described by Cornelius Wandmacher, professor of civil engineering, University of Cincinnati, Cincinnati, Ohio, during Friday afternoon's session of the joint ASEE-ECPD meeting.

Local engineering societies, industrial companies, and the University joined forces in a program of post-college training, he said.

Professor Wandmacher, who is chairman of the ECPD Training Committee, is working with others in the Cincinnati area on a "pilot" project to assist young engineers in their professional development. Cincinnati was chosen as a typical American industrial community in which to test the Committee's recommendations.

The program embraces the following six basic points of endeavor: Orientation and

SEATED AT THE HEAD TABLE DURING THE ECPD LUNCHEON ARE, *left to right*, S. C. HOLLISTER, A. G. L. MCNAUGHTON, L. F. GRANT, THORNDIKE SAVILLE, L. E. GRINTER, AND GREGORY M. DEXTER

training in industry, continued education, integration into the community, professional registration, self-appraisal, and recommended reading. Nine of the city's industrial companies, 23 local sections of national technical and scientific societies, and members of the administration of the University are participating in the program.

A total of 285 engineers and scientists have enrolled in advanced evening courses at the University of Cincinnati.

Engineering-Manpower Utilization

The steps taken by two firms toward more effective utilization of engineering manpower during the present acute shortage of engineers were also discussed at the session on Friday afternoon.

Guy Kleis, manager of the Central Technical Departments of the Westinghouse Electric Corporation, Pittsburgh, Pa., explained the Westinghouse "Three-Point Program," and Chester L. Brisley, chief industrial engineer for the Wolverine Tube Division, Calumet & Hecla, Inc., Detroit, Mich., illustrated the "sampling" techniques employed by his firm.

The Three-Point Program at Westinghouse, Mr. Kleis said, includes (1) employing nonengineers for "fringe-area" jobs; (2) purifying "engineering-area" jobs; and (3) raising the performance level of both professional and supporting personnel through an educational assistance program.

Fringe-area jobs in the electrical manufacturing industry, he stated, include semitechnical sales, purchasing, production planning and control, time and motion analysis, quality control, industrial relations, and shop supervision. Experience has proved that business administration, liberal arts, and law graduates, with supplemental training in engineering fundamentals and industry methods, can perform these functions as well as engineers, derive more honest satisfaction from the work, and possess equal or greater potential for advancement into management positions.

He described engineering-area jobs as those in which a bachelor's degree in engineering or science is a minimum requirement. At Westinghouse they were "purified" by the delegation of "all extraneous detail" to clerks and technicians. Mr. Kleis said this resulted in a 15 to 20 per cent increase in engineering output.

The "long-range, wide-range" educational program was established to meet the varying needs of all Westinghouse employees. It includes graduate and undergraduate study in engineering, science, business, and management at 16 affiliated universities and a technical-institute program for high-school graduates who want to become technicians. The management of Westinghouse not only encourages participation, but also makes substantial contributions by refunding tuition, he declared.

The second speaker, Mr. Brisley, defined sampling as an intelligent application of the laws of chance. Stating that management too often plays hunches, he asserted that the gamble can be taken out of production or management problems by making use of the work-sampling technique.

At the Wolverine Tube Division, said Mr. Brisley, the technique was used to determine time-study allowances. The general practice, he observed, is to make continuous time studies over a long period of time. However, this takes a lot of specially trained manpower, he said. Now we get the same data by work sampling, he declared, and it requires only a fraction of the man-hours needed to make continuous time studies. Observers need much less training than a qualified time-study man. Experience, he pointed out, has taught us all that the data are sufficiently accurate.

The technique, he said, was successfully applied to determine how engineers in the firm's Decatur, Ala., plant could increase their productivity. It was also used in the Detroit plant to help executives make better use of their time.

T. H. Chilton, chairman, Engineering Manpower Commission, served as chairman of the session.

Annual Engineers' Dinner

Nearly 200 engineers and engineering educators, in attendance at the Annual Engineers' Dinner, heard Horace P. Liversidge, chairman of the board, Philadelphia Electric Company, Philadelphia, Pa., review the present engineering-manpower shortage. This shortage, he said, has been occasioned in large measure by the rapid and broad industrial expansion of recent years without corresponding attention being given to concurrent demands for more technically trained men and women.

Two major segments of our society—our educators and our industrial leaders—have a vital interest in this problem, he declared. The educators have been especially cognizant of it during the past decade and their studies and recommendations deserve great credit. Industry, on the other hand, has only lately shown any serious concern about the matter.

Mr. Liversidge proposed that an initial step toward relieving the shortage of engineers can be taken by creating an atmosphere of better public understanding and an appreciation by young people of the great opportunities in the fields of engineering and scientific pursuits.

In addition to attracting increasing numbers of young people to the engineering profession, he said, the college must be prepared to cope successfully with a vastly increased student body through additional instructors; by providing for higher costs of technical instruction; and by expanding their facilities in building and equipment.

This need for expansion is one of the most important phases of the problem and, he asserted, should be given a primary place in our future planning. Its solution will certainly require the combined attention of both educational administrators and industrial leaders. However, he added, while industry is the principal cause of this shortage of engineers, it does not seem to understand the problem and thus far has evidenced almost an indifferent attitude toward its solution.

Unfortunately, industry's apparent well-being today is largely taken for granted. This, according to Mr. Liversidge, is one of the reasons for the dilemma in which we find ourselves. The bold conclusion we are forced to accept, he declared, is that industry should pay for its additional scientific and engineering brains just as it now pays for its other facilities for doing business. Industrial leaders must learn to understand that contributions in support of engineering and scientific education should be a direct charge against the business, not a charitable gift. Management has the responsibility for selling this to directors and stockholders. The outstanding fact, he said, is that the problem will not be solved unless and until those responsible for directing industry take the lead.

As part of the dinner program, Col. L. F. Grant, chairman of ECPD, briefly reviewed the ECPD annual report, which includes reports of the chairmen of the various committees and reports of the representatives of the constituent organizations.

Henry T. Heald, vice-chairman, ECPD, and Chancellor, New York University, presided.

Accrediting and Evaluation Discussed at ASEE-ECPD Meeting

RECENT developments in accreditation of educational institutions as a whole and of individual curricula, not only in ECPD and its constituent bodies, but in the institutions and other accrediting agencies as well, prompted the decision to devote the general program of the joint ASEE-ECPD meeting, held in New York, N. Y., Oct. 14–17, 1953, to the subject of engineering accrediting and the studies of the ASEE Committee on Evaluation of Engineering Education, with which the ECPD Education Committee, which is in charge of the ECPD accreditation procedures, is closely associated.

The session on engineering accrediting was held at the Hotel Statler on Friday morning, October 16, with Thorndike Saville, chairman, ECPD Education Committee, and dean of engineering, New York University, presiding. Nelson Hibshman, assistant secretary, AIEE, acted as vice-chairman.

Comments on Accrediting Agencies

To set the stage for a comprehensive understanding of some of the major elements of the accrediting problem in respect to educational institutions and accrediting agencies, Ewald B. Nyquist, secretary, Middle States Association, discussed the National Commission on Accrediting and the Middle States Association and the relations of their programs with that of the ECPD program of engineering accrediting.

Dr. Nyquist explained that the National Commission on Accrediting had come into being as an attempt to deal with the so-called evils of accrediting as viewed by the educational institutions. Among the evils, he men-

tioned the great number of accrediting agencies with which an institution might have to deal, the duplication of effort which resulted from such a large number of agencies, and the costs that the institution had to bear. In addition, there were problems concerned with standards and the possible imposition of guild practices. He listed a number of accreditation principles to which the National Commission attempted to adhere, among which were: Self-evaluation, accreditation of the institution as a whole rather than that of individual curricula, consideration of the aims and objectives of the institution in question, and the desire to minimize costs of accreditation, to operate on a nationwide basis, and to stimulate the growth and development of the institutions subjecting themselves to accreditation. It was Dr. Nyquist's opinion that the early efforts of the National Commission were confusing and nonrealistic and that they had displayed an arbitrary attitude. However, he said, the National Commission intends to pursue its program in a more realistic manner.

Turning to another accrediting agency which is organized on a regional rather than a national basis, Dr. Nyquist described the operations of the Middle States Association of Colleges and Secondary Schools, which he serves as secretary. This is the agency with which the ECPD Education Committee has cooperated recently along with representative groups from other professions, such as medicine, law, and architecture, in developing principles and procedures for co-operative evaluations of specialized curricula. The Middle States Association comprises more than 200 member institutions located in the area roughly defined by its name, Dr. Nyquist said.

A number of principles guiding the operations and objectives of MSA were listed by Dr. Nyquist, among which are the desire to help large and small institutions, to consider all educational programs and their relation to the program of the institution as a whole, to minimize cost and paper work, to consider education as it is and determine how well an institution meets its objectives, to concern itself with qualitative as well as quantitative criteria, and to preserve the freedom and autonomy of the institution.

Dr. Nyquist said that the Middle States Association is concerned with evaluation of an institution as a whole. The team of inspectors of a given institution includes members who are specialists in financial, library, personnel, and organization aspects of the evaluation procedure; and includes a representative of a state education department. Where collaboration of MSA and ECPD is involved, ECPD members of the team are the evaluators of the engineering curricula. The evaluation procedure takes two to four days. General impressions with respect to engineering are given to MSA by the regional chairman of ECPD, but no information is released with respect to the actual recommendation concerning accreditation by ECPD, which rests with ECPD itself and is known only when the annual ECPD report is published. ECPD has the benefit of MSA reports on the nonengineering evaluation of the institution. Billing of the institution is centralized within MSA in cases where ECPD and MSA collaborate. Dr. Nyquist emphasized the fact that the MSA-ECPD arrangement is a collaboration, not a merger, of the two agencies and is on a trial basis. He summarized the benefits of this collaboration by saying that each of the two agencies has the advantage of the professional personnel of the combined teams, duplication of effort is minimized, and ECPD gets additional evaluations useful in dealing with other institutions. MSA, he said, is responsible to the institutions which constitute its membership and maintains its own integrity. It does not claim to be the sole accrediting authority. Its objective is to foster and improve higher education in its area.

Needs of Students in Choosing an Engineering School

The point of view of a consulting engineer who frequently has been asked to advise students and their parents on the choice of an engineering school and who criticized ECPD for issuing lists of accredited curricula based on the meeting of minimum standards only was expressed by Gregory M. Dexter in a paper, "Our Neglected Future Engineers." He contended that wide variability in many important factors among institutions was not recognized in the ECPD lists and hence young people and their parents were uninformed in respect to these factors. He asserted that evaluation of the comparative merits of engineering schools involved, beyond the accreditation accorded by ECPD which is based on minimum standards, such factors as teacher load, cost per student, adequacy of laboratory equipment, and educational qualifications of instructional staff. Other factors of importance to prospective students, in his opinion, are the number of chapters of honorary fraternities in the institution, entrance requirements, fees, number of living alumni and their active interest in the institution, source of income, whether public or private, attitude of the institution on academic freedom, and the size of endowment funds. He also cited ten criticisms of accrediting agencies and closed with a plea for publication of the data needed by our future engineers in making a choice of the college they should attend.

Evaluation of Engineering Education

The third speaker at the Friday morning session was L. E. Grinter, dean of the graduate school, University of Florida, president ASEE, and chairman of the ASEE Committee on Evaluation of Engineering Education.

Dean Grinter stated that the Committee on Evaluation of Engineering Education had been appointed in May, 1952, by Dean S. C. Hollister, at that time president of ASEE. "The charge to the committee," he said, "was to determine the pattern or patterns that engineering education should take to provide the leadership that the profession must have 25 years from now." He then cited examples of the "increased importance of the basic sciences in engineering progress" and the reorientation of research physicists toward nuclear problems, which made it seem doubtful "if the interest will ever be returned in sufficient measure to influence greatly research in vibrations, elasticity, heat transfer, engineering thermodynamics, fluid flow, and other engineering sciences. Hence," he continued, "engineers have become responsible for the continuity of research in all the fields of engineering science. The leaders of the engineering profession 25 years hence must be engineers who are at no loss in interpreting or themselves contributing to the extensions of the fields of engineering science."

In respect to curricula changes, Dean Grinter, who was presenting a summary of the preliminary report of his committee, stated, as regards the basic sciences, which include mathematics, physics, and chemistry, that "mathematics through ordinary differential equations seems close to a minimum essential for all engineers. Chemistry deserves increased emphasis . . . . and for a larger portion of engineers considerably more than the usual freshman chemistry course is necessary." He asserted that the Committee has "indicated its belief that modern physics including nuclear and solid-state physics has become an essential study in engineering. Since the physicists' teaching of mechanics, thermodynamics, and electricity is largely duplicated in engineering courses, it is believed that better co-ordination would provide opportunity for the study of modern physics. The Committee, therefore, recommends greater emphasis upon basic science in engineering curricula."

Nine important background sciences of engineering have been recognized by the Committee, said Dean Grinter. They are: Statics, dynamics, strength of materials, fluid flow, thermodynamics, electrical circuits, fields, and electronics, heat transfer, engineering materials, and physical metallurgy. "It is believed," he reported, "that all of these studies should be represented in curricula that train engineers in research, development, or design, and that no less than seven should be integrated into every curriculum that is represented as education for engineers."

Studies in analysis, design, and engineering systems, along with the necessary background of the engineering sciences, "represent the features that distinguish engineering education from education in science on the one hand or technical institute education on the other," Dean Grinter asserted. "In all curricula except those intended for training in management or other general professional service, studies in design or in analysis leading to design should occur as an integrated study over four successive semesters. Even the most general curricula should include such studies as a continuing program for at least two semesters."

Turning his attention to "engineering courses selected for broadening purposes such as electrical engineering for nonelectricals," Dean Grinter stated that "such courses should avoid the study of special machines or devices including their construction, production, or operation. The Committee affirms its conviction," he said, "that the most important broadening courses in engineering are those listed as the engineering sciences. Additional studies in these fields are recommended in place of survey courses in engineering practice."

Dean Grinter stated that "the Committee recognizes the importance of social studies and

the humanities as an important part of an engineer's education . . . . . The Committee recommends a much broader study of the effectiveness of the social-humanistic stem of engineering education."

Dean Grinter then went on to discuss faculty selection and development. "An educational background which includes the PhD degree is the strongest evidence usually available to measure the probable usefulness in teaching and research of a relatively young candidate for a faculty position," he said. "For older persons evidence of the productivity of the individual in creative teaching and research may be gaged by other criteria, and the formal educational background is of less significance."

In respect to the development of superior teachers, Dean Grinter said: "A faculty that can be expected to provide adequate leadership for students will have at least one member in five who has achieved professional distinction by creative activities. Such persons will (1) be conducting high-grade research of an engineering or educational nature or other creative activity, including publishing of good quality; (2) be engaged in consulting work at a creative level; (3) be exercising leadership in scientific, educational, and professional societies; or (4) preferably be serving in a combination of such activities."

Another section of Dean Grinter's report deals with accreditation of curricula. "For proper handling of accreditation," he said, "ECPD needs improved standards for measuring the effectiveness of the educational process and also criteria that distinguish engineering curricula from those in science and from those in technical institutes." The Committee has devised the terms "professional-scientific" and "professional-general" education to distinguish between curricula design for the training of two separate groups of engineers. In order to raise the standards of accreditation of engineering curricula, Dean Grinter recommended that "the accreditation process be reorganized on the basis of a distinction between professional-scientific curricula and professional-general curricula." Professional-scientific curricula are those embodying the characteristics previously mentioned, intended for the instruction of engineers for research, development, or design. Professional-general curricula are those designed to produce engineers "(1) to serve in areas between engineering, management, law, real estate, or agriculture; (2) between engineering and a branch of science where the opportunities to apply engineering analysis and design may be limited; (3) between engineering and a highly applied technology, such as production processes, operation, construction, or air conditioning, welding, or wood technology."

To ECPD, Dean Grinter recommended "liberal acceptance of experimental programs that meet the definition given of engineering education . . . . The length of the curriculum should be one such factor subject to wide experimentation. The Committee does not foresee difficulty in meeting within a four-year program its recommendations for an accredited professional-scientific engineering curriculum plus all of the specialized courses of the degree-granting department, but it believes that specialized engineering courses are of far less value in professional-scientific education than a broad background of engineering science and its application in one field of analysis and design."

Dean Grinter's report ended with a statement that "there appears (to be) merit in identifying those curricula which meet criteria substantially above the minima. The major factor in such identification should be the background and eminence of the faculty and its attention to creative teaching."

Discussion of Accreditation and Evaluation

The extensive and spirited discussion which followed Dean Grinter's report was summarized by S. C. Hollister who said that the speakers had approached the subject of accreditation from three points of view: (1) that of the institution seeking accreditation, (2) that of the student and his parents, and (3) that of professional licensure. He cited as three concepts of the accreditation process (1) the classification of the relative qualities of a college; (2) the minimum standards of an institution; and (3) stimulation of the improvement of individual programs.

Accreditation by ECPD, he pointed out, had been set up as an adjunct to the licensing of engineers. There was evidence that the needs of the profession are changing rapidly, and he asked what was being done to meet change. Also, there had been introduced into the accreditation picture a new element which suggested the possibility of indicating schools that are doing a superior job in engineering education. The central theme which ran through the discussions, he said, was an indication that the public does not understand the engineering schools.

The most important need at present, he said, lay in the evaluation of engineering education. There was a need for a definitive statement of objectives and a unification of patterns to meet these objectives. What would be done at the campus level with the preliminary report of Dean Grinter's committee was therefore of great importance, and the question of accreditation would be secondary until other facts were known. It was the quality of the faculty, he said, which defined the nature and set the tone, level, and objectives of engineering operations. However, there was no good way to measure the functions of the faculty. Judgment and experience counted greatly, he asserted, but quantitative specifications might result in a "hardening of the categories." Accreditation must not standardize or paralyze education, he contended, nor must it interfere with the growth of sound experimentation. It must provide for a shift of educational attack, but not a shift of objectives to meet standards of a quantitative nature.

There was confusion in respect to the objectives of higher education, he said, and then listed three objectives which appeared to him to be valid: (1) Education for leadership for intelligent progress in a dynamic world; (2) high scholarship; and (3) training for responsible practice of engineering, which is something the engineering profession owes to the community.

In closing, Dean Hollister stated further that accrediting was not an end in itself but an aid to the objectives which education set for itself.

ECPD Elects Officers at Twenty-First Annual Meeting

AT the twenty-first annual meeting of the Engineers' Council for Professional Development, held in New York, N. Y., Oct. 14–17, 1953, in co-operation with the American Society for Engineering Education, Col. L. F. Grant, field secretary, The Engineering Institute of Canada, was re-elected chairman. Other officers elected were: Vice-chairman, M. D. Hooven, electrical-engineering department, Public Service Electric & Gas Company, Newark, N. J.; secretary, Nelson Hibshman, assistant secretary, American Institute of Electrical Engineers; and assistant secretary, S. L. Tyler, secretary, American Institute of Chemical Engineers.

Representatives of the participating ECPD societies whose appointments were announced at the meeting are: H. S. Rogers (ASCE), J. P. Neilson (AIME), A. C. Monteith (ASME), R. H. Barclay (AIEE), J. R. Kaye (EIC), W. L. McCabe (AIChE), and Thorndike Saville (ASEE). To serve as chairmen of the standing committees of ECPD the following selections were made public: S. Paul Shackleton, Guidance Committee; Thorndike Saville, Education Committee; N. W. Dougherty, Student Development Committee; R. G. Warner, Recognition Committee; Scott Turner, Ethics Committee, and C. S. Rich, Information Committee.

The Executive Committee of ECPD for the coming year will consist of the officers and H. S. Rogers (ASCE), C. E. Lawall (AIME), G. R. Cowing (ASME), M. D. Hooven (AIEE), E. V. Buchanan (EIC), Thorndike Saville (ASEE), W. L. McCabe (AIChE), and R. G. Warner (NCSBEE).

Twenty-Second Annual Meeting to Be Held at Cincinnati

The date of the twenty-second annual meeting was set for Oct. 22 and 23, 1954. It will be held at Cincinnati, Ohio, where opportunity will be afforded for direct observation of the operation of the Training Committee's project there in co-operation with the industries, university, and local engineering societies in providing a program of post-college development of the young engineers of that area.

Administrative Session

The administrative session of ECPD, held at The Engineers' Club, New York, N. Y., on Thursday evening, Oct. 15, 1953, followed an informal dinner of members of the Council and ECPD committees and a closed session at which the Education Committee reported on its accreditation activities for the year. A summary of this discussion is reported elsewhere in this issue (pages 1036–1037).

Colonel Grant presided at the administrative session. Approval was voted of the minutes of the twentieth annual meeting held at Chicago, Ill., Sept. 5 and 6, 1952, and of the actions of the Executive Committee as reported to members of the Council through the minutes of the meetings of that committee. The annual statement from the treasurer (United Engineering Trustees, Inc.) and the report of the auditors were received; and a budget of estimated income and expenditures for 1953–1954 was approved.

Reports of Committees

A practice was established several years ago of preprinting in pamphlet form the reports of the Chairman and Committees. Because of the availability of this pamphlet to members of the Council in advance of the meeting, only the high lights of the individual committee reports need to be presented orally. The preprinted reports, amended if necessary, are reissued in the final report of ECPD which also contains the financial report and the lists of accredited curricula of engineering schools and accredited programs of technical institutes. These reports are summarized in the report of the chairman.

Reports of Representatives of Constituent Societies

In addition to the reports of the standing committees of ECPD, each constituent society, through its representatives on the Council, reviews such activities and actions taken by the societies as are particularly pertinent to ECPD. Representatives of ASME on ECPD for the year 1952–1953 were A. C. Monteith, Guy R. Cowing, and William F. Ryan. The report of the ASME representatives follows:

Report of ASME Representatives

At the Semi-Annual Meeting of the Society in Los Angeles, Calif., June 29, 1953, the Business Session voted to submit to the members, for ballot, changes in the Constitution to bring requirements for ASME membership grades into agreement with the recommendations of ECPD for uniform grades.

Efforts were made by the ASME Education Committee to strengthen its representation on the committees of ECPD that inspect curricula for accrediting.

In June, 1953, the ASME Council voted to support the position of ECPD as the authoritative accrediting agency for the engineering profession and to require that any review of an educational process be made only through procedures approved by ECPD.

ASME appropriated $700 as its share of ECPD's contribution of $3000 to the ASEE project on the Evaluation of Engineering Education.

ASME has, over a long period, concerned itself with the development of ingenuity in the educational process. On June 4, 1953, the ASME Board on Education and Professional Status adopted the following statement on "Ingenuity—Its Place in the Undergraduate Engineering Education:"

"The Board on Education and Professional Status of ASME over a long period has been giving consideration from time to time to the development of creativeness, ingenuity, or imagination that might be encouraged in undergraduate engineering curricula as well as in the development of the young engineer after graduation. The Board here presents its statement of viewpoint and recommendations on this important problem:

Statement of Viewpoint

"1 To develop this idea it is necessary first to make an assumption—which we feel can be supported by the observations of those most interested in the study of the human being. The assumption is this: That imagination, creativeness, or ingenuity is a characteristic inherent in all human beings. This quality has not been subject to measurement in the same sense as intelligence. However, it seems safe to assume that it exists in all people in varying degrees at birth.

"2 It seems evident that expressions of this characteristic are noted in the young person in those areas in which he has accumulated a certain amount of knowledge. The degree to which this is expressed seems to be in some way related to the intelligence of the individual and the methods by which his knowledge was accumulated.

"3 It would, therefore, be reasonable to assume that the amount of this characteristic expressed by the individual in later life is dependent upon (*a*) The accumulation of knowledge in any given area; (*b*) The methods used during this accumulation which have added to or subtracted from the amount of this quality he originally possessed.

"From the above assumptions the ASME Board on Education and Professional Status makes the following recommendations to the ASEE Committee now evaluating engineering curricula:

"1 That every effort be made to insure that any engineering curricula are sound in the development of sound knowledge of the engineering student in basic engineering subjects.

"2 That emphasis be placed on developing within the student the realization that this knowledge is necessary in order that he may have respect and interest for the 'unknown' rather than seek the security of the 'known.'

"3 That careful attention be paid to methods of teaching in these subjects so as to insure that the methods used are such as to contribute to rather than detract from the normal creative quality the student already possesses. Example: That he learn by reason rather than by rote.

"4 That efforts to encourage the student in increasing his skill in this ability only be made in the area in which it is certain he has already received the knowledge which would permit its use."

Part-Time Graduate Study Inaugurated at Cincinnati

Industry, Engineering Societies, and University Co-Operate With ECPD in Community Project

A TOTAL of 285 practicing engineers and scientists enrolled in the recently expanded group of graduate courses offered this year for the first time on a part-time basis through the joint plan of the evening college and the graduate school of arts and sciences at the University of Cincinnati.

So great was the response to the program that additional class sections were required in three of the nine courses, and six of the classes were declared closed at maximum enrollments. The total number of course enrollments was 290.

This is the first in a series of yearly offerings in planned sequences designed to meet the needs of college graduates in the fields of physics and chemistry, and in aeronautical, civil, chemical, electrical, mechanical, and metallurgical engineering. The program will enable young men to study at advanced levels while employed in the Cincinnati area.

Advanced courses in mathematics and science may be integrated with an appropriate group of related graduate engineering courses from selected fields in order to compose degree programs suitable to the interest of the individual student.

The program, which was first announced by the board of directors of the University last March, came to fruition as the result of the joint efforts of the engineering societies, a local-industry committee, and the administration of the University. These three groups have participated during the past year in a nationwide program of the Engineers' Council for Professional Development, which is aimed at stimulating the continued personal growth of the young engineer, particularly in the first five years after graduation from college.

EMC on Universal Military Training

AS is generally known. President Eisenhower, during July, filled three vacancies on the National Security Training Commission and directed the reconstituted five-member group to report to him by December 1, 1953, on the feasibility and desirability of operating a military training program to supply trained nonveteran reserves concurrently with operation of a Selective Service System to provide men to the Armed Forces. In short, the National Security Training Commission was requested to submit a report to the President on the feasibility at this time of Universal Military Training. The Commission is composed of Maj. Gen. Julius Ochs Adler as chairman, Warren Atherton, Karl T. Compton, Lieut. Gen. Raymond S. McLain, and Adm. Thomas C. Kinkaid as members.

The Engineering Manpower Commission of Engineers Joint Council has had the ques-

tion of Universal Military Training under study for several years. Recently, it prepared a statement on Universal Military Training as it would affect any program "for the most effective utilization of engineers in the national effort." On October 20 this statement was presented to and discussed with Major General Adler and with Edgar Shelton, who is executive director of the National Security Training Commission.

The EMC statement emphasized the necessity in any consideration of Universal Military Training to study not only its inherent nature and implications, but also its probable and potential effects on the over-all manpower picture in any future, partial, or full mobilization. EMC recommended that if UMT is adopted, specialized training in the UMT program be reduced to a minimum in view of its rapid obsolescence and that the over-all program be shortened to interfere as little as possible with the normal cycle of higher education so vital to the development of our technological manpower resources.

EMC strongly recommended that UMT trainees be returned to civil life and the jurisdiction of Selective Service. Only in this way can the vital principle of Selective Service be assured.

The following is a summary of the Engineering Manpower Commission's recommendations on UMT:

1 The instructional program for Universal Military Training emphasizes the basic military subjects and minimizes specialist training as being subject to rapid obsolescence.

2 In any implementation of UMT, the training programs be planned to provide a minimum dislocation of the processes of higher education so necessary to the technology of preparedness.

3 Universal Military Training be completely separated from the construction of our military reserve forces and be regarded merely as a part of the basic required education of our male populace.

4 Those who complete UMT be returned to civil life and the jurisdiction of the Selective Service System.

5 To give effect to recommendations 3 and 4 afore-mentioned, the statutory provision involving provisions for an obligated period of service in the military reserve forces as now contained in Section 4 (d) of the Universal Military Training and Service Act of 1951 (P.L. 51) be repealed.

6 The problems of constructing a realistic, voluntary, dependable, immediately available reserve be the subject of intensive study apart from any considerations of Universal Military Training.

Copies of the complete EMC document on Universal Military Training are available upon request.

Guggenheim Foundation Establishes Institute at Columbia on Air-Flight Structures

ESTABLISHMENT of a major new educational and research unit at Columbia University, to serve as a national center for the study of air-flight structures, particularly in the supersonic range, was announced Oct. 23, 1953, jointly by Columbia University and the Daniel and Florence Guggenheim Foundation, which has provided a grant of $329,000 to establish the new center.

The new unit will be known as the Daniel and Florence Guggenheim Institute of Air-Flight Structures. It will be organized within the Columbia University Engineering Center. Preliminary organizational steps are proceeding at once, and the new Institute will begin operation on Jan. 1, 1954.

Harry F. Guggenheim, president of the Daniel and Florence Guggenheim Foundation, explained that the new Institute will have a fourfold purpose: To train exceptionally qualified graduate students in the comparatively new field of air-flight structures; to conduct research in aircraft structure and design, especially for supersonic flight; to act as a national clearinghouse for technical information in this field; and to disseminate technical knowledge regarding air-flight structures.

Mr. Guggenheim pointed out that "the principal purposes of the new Institute are to focus research attention on the problems of high-speed aircraft design and to train men who will become leaders in this development. Until more is known about high-speed aircraft structures, and more men are available who are qualified by knowledge and training to design such structures, the development of fast aircraft and guided missiles will be held back.

"The Daniel and Florence Guggenheim Foundation, which sponsors Jet-Propulsion Centers at Princeton University and the California Institute of Technology, is happy to sponsor this new Institute at Columbia. We believe that the progress of aviation, particularly at high velocities, will be greatly aided by the work to be done at this new center," Mr. Guggenheim concluded.

John R. Dunning, Mem. ASME, dean of the school of engineering, under whose direction the new Institute will operate, declared that "the Institute will fill a gap in research that might have materially retarded the development of future aircraft, particularly at the higher velocities, where power plants already exceed the ability of airframes to contain them."

Meetings of Other Societies

Dec. 17
Seventeenth Wright Brothers' Lecture, sponsored by IAS, Chamber of Commerce Building Auditorium, Washington, D. C.

Jan. 13–20, 1954
Australian and New Zealand Association for the Advancement of Science, thirtieth meeting, Canberra, A.C.T., Australia.

Jan. 18–22, 1954
American Institute of Electrical Engineers, winter general meeting, Statler Hotel, New York, N. Y.

ASME Calendar of Coming Events

March 10–12, 1954
ASME International Meeting, Hotel Del Prado, Mexico, D. F.
(Final date for submitting papers was Nov. 1, 1953)

March 31–April 1, 1954
ASME Management-Engineering Conference, Benjamin Franklin Hotel, Philadelphia, Pa.
(Final date for submitting papers was Nov. 1, 1953)

June 14–17, 1954
ASME Oil and Gas Power Conference, Hotel Muehlebach, Kansas City, Mo.
(Final date for submitting papers—Feb. 1, 1954)

June 14–18, 1954
Second U. S. National Congress of Applied Mechanics, University of Michigan, Ann Arbor, Mich.

June 20–24, 1954
ASME Semi-Annual Meeting, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers—Feb. 1, 1954)

Sept. 8–10, 1954
ASME Fall Meeting, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers—May 1, 1954)

Sept. 13–24, 1954
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Commercial Museum and Convention Hall, Philadelphia, Pa.
(Final date for submitting papers—May 1, 1954)

Sept. 26–29, 1954
ASME Petroleum Mechanical Engineering Conference, Statler Hotel, Los Angeles, Calif.
(Final date for submitting papers—May 1, 1954)

Oct. 28–29, 1954
ASME-AIME Joint Fuels Conference, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers—June 1, 1954)

Nov. 28–Dec. 3, 1954
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1954)

The Guaranteed Wage

BUSINESSMEN have learned that regular employment and steady pay for employees benefit the employee, the employer, and the community alike, the Chamber of Commerce of the United States reported in a comprehensive study of the guaranteed-wage problem.

Among the conclusions reached in the study, which was published under the title, "The Economics of the Guaranteed Wage," were that "substantial progress" has been made in ironing out seasonal and other short-run unemployment, and that the guaranteed-wage plan, which a few companies have had in effect for many years, is still not winning wide acceptance.

Because they realize that steady employment helps to maintain labor skills and consumer buying power, and to reduce costs, businessmen have been trying to reduce labor turnover, the report said.

Few of them, however, have turned to the guaranteed-wage idea. As evidence, the report cited studies by the Office of War Mobilization and Reconversion in 1947, and by the Bureau of Labor Statistics in 1952, which failed to indicate any increase in the number of workers

covered by guaranteed-wage plans in that period.

Partly as a result of the failure of the guaranteed wage to win wide acceptance, some union leaders are trying to link it with state unemployment compensation, the report states. Such a tie-in would make benefits more attractive than wages, and the consequence would be to eliminate the incentive to work, the report adds.

Taking up the argument that the guaranteed wage would help prevent a depression, the report points out that other factors besides purchasing power influence economic conditions, among them being scientific inventions, birth of new industries, war and its aftermath, taxes, and ever fluctuating price changes.

The report concludes that "the demand for the guaranteed wage is in reality a demand for adequate job opportunities, for high-level employment."

"There is reason to believe that if we maintain reasonably stable prosperity in the years ahead, this is what the American people want and will settle for."

The report urges management to be aggressive in shifting and adapting policies to provide continuity of employment and wage income. Copies of the report may be obtained from Economic Research Department, Chamber of Commerce of the United States, Washington 6, D. C., for 50 cents a copy.

Conference Studies Manpower Scarcity

NATIONAL authorities nominated by the National Manpower Council to look into the utilization of scientific and professional manpower concluded their conference in general agreement that there would be a continuing shortage of trained personnel for the medical, teaching, and engineering professions through the next decade.

The council, a group of 16 distinguished citizens, was set up two years ago at the Columbia Graduate School of Business by President Eisenhower under a Ford Foundation grant.

"The determination of policies respecting the private preserve of organized groups which are primarily and understandably concerned with protecting and advancing the interests of their members," declared James D. Zellerbach, chairman of NMC, in opening the five-day conference, called by the council, on how to improve utilization of the country's scientific and professional manpower.

Sixty-six leaders in the fields of engineering, medicine, education, science, industry, government, and the armed services from all over the United States took part in the conference from October 7-11 at Arden House on Columbia University's Harriman Campus at Harriman, N. Y.

Practical Methods Discussed

The conference sought practical methods of carrying out the recent recommendations on manpower utilization by the National Manpower Council in its book, "A Policy for Scientific and Professional Manpower."

In addressing the conference on October 7, Mr. Zellerbach said that an understandable failure to grasp the interrelatedness of policies for scientific and professional manpower and a public indifference to the significance of these policies "could combine to cause serious injury to our national well-being and strength." Mr. Zellerbach is president of the Crown Zellerbach Corporation, San Francisco, Calif., and an alternate delegate to the General Assembly of the United Nations.

Kenneth E. Boulding, professor of Economics at the University of Michigan, gave the conference "An Economist's View of the Manpower Concept." He warned against seeking better utilization through governmental allocation measures or other steps which involve undesirable interference with the workings of the market economy.

Frank Pace, Jr., former Secretary of the Army and now executive vice-president of the General Dynamics Corporation, spoke on "Manpower Utilization From the Point of View of Top Management." Drawing on his experiences as Director of the Budget, Secretary of the Army, and in business, Mr. Pace illustrated the gains that can be made through "a genuine willingness on the part of management to venture into the experimental areas of manpower utilization." He pointed out that "seemingly inflexible principles which are applied to the management of men have got to yield to social and political pressures from time to time." He noted that significant improvements in utilization had been made possible by the policy of racial integration in the armed services, and he stressed the unique role of leadership in manpower utilization.

"Leadership," said Mr. Pace, "is that quality that lifts men and women toward whom one has responsibility out of their ordinary selves and permits them to accomplish in their fields more than they could if the leader were not there to impose his personality upon them. Of all the qualities which go into leadership, probably the most important is the capacity to command instinctive respect. But in order to command instinctive respect, one must have qualities of integrity, self-confidence, and acumen."

In addition to general sessions in which all of the participants joined, the Conference program provided for meetings by three working groups in the fields of engineering, medical, and teaching personnel.

Proceedings to Be Published

The proceedings of the entire Conference will be published by Columbia University Press early in 1954.

The engineering group was under the chairmanship of Frank W. Pierce, a director of the Standard Oil Company of New Jersey and a member of the National Manpower Council. George M. Maverick, director of the Employee Relations Department of Standard Oil Development Company, opened the meetings of this group with a paper on the utilization of engineers and supporting technical personnel.

The findings of the engineering group, reported to the Conference as a whole, noted that improved utilization can be defined as any step which increases the quantity or quality of goods and services produced with given amounts of capital, using the same number of technological personnel, or, alternatively, as any step which maintains a given level of output in terms of quantity and quality, with a smaller number of such personnel.

12 Steps to Improved Utilization

The engineering group agreed on the following points in connection with securing improved utilization:

1 The first step must be to make more effective utilization the focus of genuine and continuing attention at all levels of an enterprise.

2 If improved utilization begins at any one point, that point is improved training, not only in the colleges and on the job, but also in the elementary and secondary schools.

3 Much more has to be learned about the jobs which engineers and related supporting personnel are doing in order to reassign duties among different kinds of technical personnel.

4 Engineers have to have the best tools and instruments, as well as good supporting personnel, if they are to make efficient use of their training and talents.

5 Improved utilization requires effective communication from management to engineering and related personnel about the objectives of their work. Moreover, since the actual changes in utilization take place well below the level of top management, effective communication upward is also essential.

6 Changes in the organization of enterprises can open up new possibilities for the better utilization of personnel. Too much organization may prevent necessary freedom in the allocation of effort, while too little organization may result in duplication, lack of proper priority, and unwise allocation of personnel to projects.

7 Improved utilization can also be achieved by keeping technologically trained people at the technological jobs for which they are best fitted through incentives in the form of status, recognition, and money rewards which are generally associated with jobs in management and sales.

8 Utilization can be improved through recognition of the fact that an individual's effectiveness and interest on the job is affected by many things outside of his work.

9 Attempts to improve utilization must always take into account normal human resistance to changes in the setup which people know.

10 Utilization can be improved by management, not only by calling upon the manifest capacities of engineering personnel, but also by making an effort to develop their potential capacities through imaginative assignment and training.

11 Efforts to improvement utilization must distinguish among what can be accomplished to secure immediate gains, what may yield results only after some investment of time and money, and what changes are fundamental and long range in character.

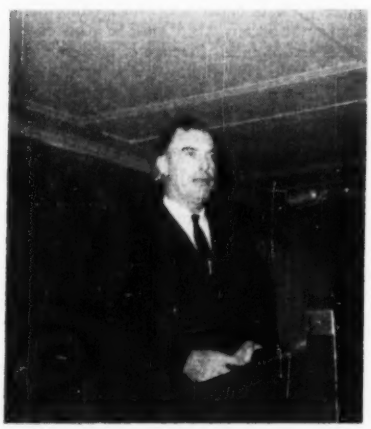
12 Improved utilization is achieved not through any single device, but by the use of many related measures.

Joint AIME-ASME Fuels Conference in Chicago—A Big Success

THE sixteenth annual Fuels Conference of the AIME Coal Division and the ASME Fuels Division was held at the Conrad Hilton Hotel, Chicago, Ill., October 29-30, with the Chicago Sections of the two societies cooperating. More than 300 registered for the conference which, headed by local committeemen, Carl T. Hayden and John R. Michel, Fellow ASME, offered a program which included four technical sessions, two luncheons, and a banquet.

Coal's Competition Discussed

Coal took a look at its current competition. Tom Pickett, executive vice-president, National Coal Association, at the Thursday luncheon, referred to the inroads of dieselization in transportation, to gas and oil in the field of home heating, and the coming of imported residual oil into coal's markets. He



TOM PICKETT ADDRESSES LUNCHEON MEETING

emphasized the necessity for maintaining a strong coal-producing industry. "In today's world," he said, "no nation can remain strong without an adequate coal supply. In another world conflict the outcome might very well depend upon the productive capacity of the coal industries behind the lines of battle—coal for the steel mills, for the electric utilities, the atomic-energy plants, the explosives industries, and for conversion into synthetic fuels and a thousand-and-one other uses."

Natural Gas

Natural gas was covered Friday morning by K. B. Nagler, vice-president, operation, of Peoples Gas Light & Coke Company, in his informative paper on natural-gas supply for Chicago and the Middle West. He said that despite the enormous expansion of the natural-gas industry, the proved recoverable natural-gas reserves in the United States have been increasing more rapidly than the consumption. Citing the American Gas Association estimates of natural-gas reserves for Jan. 1, 1948, 1951, 1952, and 1953, Mr. Nagler observed that on the assumption that the rate of production will soon be about 8 trillion cu ft per year, a life of 25 years is indicated. "Deeper drilling and offshore gas pools may serve to slow up the rate of increase of natural gas at the field. In the New England area high-priced natural gas has to compete with a well-developed high-Btu oil-gas process. Certain balancing factors are making themselves felt."

"After natural gas—what?" Mr. Nagler asked in conclusion. "Of the presently known sources of primary energy, only coal appears to be so plentiful as to be a future source of gas. A complete gasification process with upgrading of gas to high heating value by synthesis seems indicated. The industry already is studying the problem of replacement when natural-gas reserves begin to decrease significantly."

Fuels Research

Robert E. Wilson, board chairman, Standard Oil Company (Indiana), principal speaker at the Friday luncheon, brought his listeners up to date on research in fuels for internal-combustion engines. Dr. Wilson predicted that even at the distant time when there is not enough liquid petroleum to meet the demand, the industry will have natural gas, oil shale, and finally, coal, from which it can make liquid fuels.

A. D. BAILEY SPEAKS AT FUELS MEETING

The papers on the program for the technical sessions were presented in the exact order listed on page 751 of the September issue of MECHANICAL ENGINEERING, and they will be available as published by either, or both, of the participating societies. The precise title of J. D. A. Morrow's paper is "Coal Developments in the USSR." It was discussed by L. E. Young, Paul Weir, L. C. Campbell, Gordon MacVean, and others. Information proffered was that there are 235 continuous mining machines of all types in the United States and some more in Canada. Sixty-five machines will probably be added so that at the end of the year there will be about 300 in use.

F. S. Blackall, jr., Speaks at Banquet

The banquet was held Thursday evening and presided over by Alex D. Bailey, Hon. Mem. and past-president, ASME. F. S. Blackall, jr., president ASME, and M. D. Cooper, chairman-elect, Coal Division, AIME, extended official greetings to the members of the two societies. Mr. Blackall outlined the status of the campaign for a new engineering societies' building, stating that the present building is obsolete, the societies having grown tenfold in recent years. H. W. Johnson, vice-president, Inland Steel Company, principal speaker, presented a history of the steel industry in the Chicago area, which produces 22 per cent of the steel of this country. He assured the members that they would have a good customer in the steel industry for a long time to come.

SPEAKERS' TABLE AT THE BANQUET OF THE JOINT AIME-ASME FUELS CONFERENCE, CHICAGO, ILL., OCT. 29-30

(*Left to right:* J. R. Michel, E. F. Obert, F. S. Blackall, jr., A. D. Bailey, Hjalmar Johnson, M. D Cooper, H. F. J. Hebley, C. G. Ball, and C. T. Hayden.)

A high point of the banquet was the presentation of the Percy Nicholls Award for notable scientific or industrial achievement in the field of solid fuels, conferred by the ASME Fuels Division and the AIME Coal Division, to Henry F. Hebley, Fellow ASME, research consultant of Pittsburgh Consolidation Coal Company. Clayton G. Ball made the presentation.

The next Fuels Conference will be held at the William Penn Hotel, Pittsburgh, Pa., Oct. 28–29, 1954. Also at the joint executive committee meeting on Thursday afternoon it was decided that the 1955 Conference will be held at The Pennsylvania State College, State College, Pa.—1955 being the college's centennial year.

The women accompanying their husbands to the Conference had their choice on Thursday of tours of the Art Institute of Chicago, the Chicago Museum of Natural History, and Marshall Field & Company, or to see "The Robe," the first motion picture in cinemascope, at State Lake Theater. On Friday there was a luncheon at the Kungsholm Restaurant.

Fuels Conference Preprints

Pamphlet copies of the following ASME Joint Fuels Conference papers are available from ASME Order Department, 29 West 39th Street, New York 18, N. Y.

See page 1043 for details

Paper No.	*Title and Author*
53—FU-1	Natural-Gas Supply for Chicago and the Middle West, by K. B. NAGLER
53—FU-2	The Midwest Solid-Fuels Situation, by W. H. VOSKUIL

Junior Forum

Conducted by Joseph Schmerler, Jun. ASME[1]

Six Issues in Search of an Author

By Warren R. Thompson[2]

LUIGI PIRANDELLO wrote a play entitled, "Six Characters in Search of an Author." We have paraphrased his title somewhat to suit our purpose. The words, as we have used them, state exactly what is our intention. During the coming year Junior Forum will allocate six issues for reader contributions. The remaining six issues will be used to report the topics of interest to Juniors which are discussed at the various national meetings of the Society.

In a survey of the Junior Members of the Society, conducted by the National Junior Committee, one of the questions asked was, "Would you be willing to contribute to Junior Forum?" More than 50 per cent of those asked indicated that they would and wanted to know how to go about making that contribution. It is in the hope of providing a better insight into this contributing process that this article is written.

Purpose of Junior Forum

The Junior Forum is under the direction of the Junior Forum Subcommittee of the National Junior Committee. Junior Forum is used to describe the activities of the National Junior Committee; report on the Junior sessions at the various national meetings of the Society; discuss various phases of professional development and industry-training methods, and report on some of the activities of the Section Junior Groups when it is thought that such activities would be of interest to the Juniors throughout the country.

The Junior Forum is also used for the solicitation of comment and distribution of information on subjects of interest to men starting their professional careers. It provides a means for expressing the aspirations of the young engineers. With better than 24,000 Junior Members in the Society, there must be many experiences and problems that are of interest to the membership as a whole. If you have a problem, state it, discuss it, and give a solution if possible. If no answers have been devised, give what you consider to be the best solutions to the problem. One word of caution at this point, however—Junior Forum is not used primarily for the presentation of papers on technical subjects, subjects that belong more properly within the jurisdiction of the various professional divisions of the Society. With this limitation in mind, the field is wide open for the use of Junior Forum.

Preparation of the Paper

The Junior Forum has approximately one page in MECHANICAL ENGINEERING. To fill this page, articles must run from 1200 to 1500 words depending upon paragraph headings, length and number of paragraphs, footnotes, bibliographies, and illustrations. Whenever possible, articles are published as received. Some slight editing, however, may be done.

There are certain rules that should be followed in the preparation of articles. Basically, they are a reiteration of the rules given in high-school and college-English classes. Spelling and grammar should be correct. Punctuation should be properly used. Elementary requirements? Yes, but an amazingly large number of papers are delayed in publication because these simple rules have not been followed.

More specifically, articles should be typewritten, double-spaced on one side of the page. A border of approximately $1\frac{1}{2}$ in. should be left at the top, right, and left-hand sides of each sheet. The first page should leave 4 in. of open space at the top. All illustrations should be clearly titled and described so that they will not be lost. Each page should be numbered and the completed manuscript stapled together.

These are the basic rules on the mechanics of preparing a paper. A more complete and detailed description has been prepared by ASME in the form of a pamphlet entitled "An ASME

[1] Design engineer, H. K. Ferguson, New York, N. Y.

[2] Design engineer, United Engineers & Constructors, Inc., Philadelphia, Pa. Jun. ASME. Member of the National Junior Committee.

C. E. DAVIES, SECRETARY ASME, TOURS SOUTHWEST

(C. E. Davies, while attending a meeting of the Professional Engineers' Examiners in San Antonio, Texas, visited the Southwest Research Institute in that city, Oct. 30, 1953. Mr. Davies, *shown center*, discusses new scientific developments with C. Desmond Pengelley, *left*, chairman of engineering mechanics of SWRI, and Charles E. Balleisen, *right*, managing editor, Southwest Technical Calendar. He also visited the Tampo Manufacturing Company and discussed the organization of the San Antonio Group of ASME with Cleal Falke, Tampo works manager and chairman of the local group.)

Paper, Its Preparation, Submission, Publication, and Presentation." It is available for 50 cents (20 per cent discount to ASME Members) by writing to: ASME Order Department, 29 W. 39th Street, New York 18, N. Y.

Submission of the Paper

Now you have a well-written paper in hand and you are wondering what to do with it. This part, fortunately, is the easiest of all. Just mail two copies to: Junior Forum, Editorial Department, MECHANICAL ENGINEERING, 29 West 39th Street, New York 18, N. Y.

The Junior Forum Subcommittee of the National Junior Committee will review each paper received and will either recommend it for publication or make suggestions to the author for revisions before publication. The author of each paper recommended for publication will be informed of the approximate date of publication at least one month in advance of the issue date and be given a copy of his article as submitted for his approval.

It is hoped that this information will answer many of the questions raised on how to contribute to Junior Forum. This section of MECHANICAL ENGINEERING is for Junior Members of the Society to use as a true forum in the discussion of the problems and experiences encountered in the course of professional development. The National Junior Committee sincerely wishes that the younger members avail themselves of the opportunity to use this space.

Call for Applications for Freeman Fellowship

THE far-reaching aims of a famous American engineer, the late John R. Freeman, past-president of both ASCE and ASME, are being implemented once again by the offering of another Freeman Fellowship. The purpose of the present award remains the same as when the fellowships were established in 1924—to aid and encourage young engineers in promoting the science and practice of hydraulic engineering.

Alternately conducted by ASCE and ASME, the 1954 award for study or research project to be completed in 1955 is being arranged by the ASME Freeman Fund Committee.

The committee has established the following rules:

1 Applicants must submit a program of study or research in hydraulics or related fields, covering a period of at least nine months starting in 1954. A statement of funds needed from the fellowship should accompany applications.

2 Applicants must furnish evidence of qualification to carry out the proposed program.

3 Applicants must be citizens of the United States and members in some grade of either of the two co-operating societies.

4 The Freeman Award Committee will give preference to projects bearing importantly on the defense effort.

5 Applications should be submitted to the Freeman Fund Committee, care of the Executive Secretary, ASME, 29 West 39th Street, New York 18, N. Y., by Feb. 1, 1954. Announcement of the award will be made on March 15, and the recipient must make a report in English within 60 days of completion of his project.

The maximum amount of grant from the Freeman Fund to a winning applicant has been $2500.

James L. Head Elected UET President

UNITED Engineering Trustees, Inc., elected officers for the ensuing year, naming James L. Head as president to succeed R. F. Gagg, who served as president for the past two years. Mr. Head is a mining engineer with the Anaconda Copper Mining Company. He has been active in the work of the American Institute of Mining and Metallurgical Engineers, whom he has represented on the Board of UET since 1947. He was chairman of Engineering Societies Library for the past two years and vice-president of UET. He is a past-president of the Mining and Metallurgical Society of America.

Other officers elected were Gail F. Moulton of Rockefeller Brothers, Inc., and Walter J. Barrett of New Jersey Bell Telephone Company, vice-presidents; Waldo G. Bowman of McGraw-Hill Publishing Company, treasurer; Joseph L. Kopf, treasurer ASME, of Jabez Burns & Sons, Inc., assistant treasurer; John H. R. Arms was re-elected as secretary and general manager, a position he has occupied since 1933. Mr. Moulton was elected chairman of the Finance Committee and Mr. Gagg, chairman of the Real Estate Committee.

UET was incorporated in 1904 by the societies of civil, mining, mechanical, and electrical engineers, for "the advancement of the engineering arts and sciences in all their branches and to maintain a free public engineering library."

Actions of the ASME Executive Committee

At a Meeting in Rochester, N. Y., Oct. 6, 1953

A MEETING of the Executive Committee of the Council was held in the Hotel Sheraton, Rochester, N. Y., on Oct. 6, 1953. F. S. Blackall, jr., chairman, presided. In addition to Mr. Blackall there were present: H. E. Martin, A. C. Pasini, E. S. Theiss, and W. F. Thompson of the Committee; E. H. Hanhart, vice-president; R. L. Goetzenberger, director; William G. McLean, vice-president elect; C. E. Davies, secretary; Ernest Hartford, executive assistant secretary; and O. B. Schier, II, meetings manager. The following actions were of general interest:

Foreign Dues Policy

A policy regarding dues of members in foreign countries has been in effect since Nov. 25, 1945, and has received annual action since. Accordingly, the Committee voted that for countries other than Mexico, the following policy, as approved in 1945, be extended for another year:

1 That the Society adopt a policy requiring all dues to be paid in United States dollars.

2 If such payment becomes excessive, upon request the Society may put the foreign member on suspended dues list without service from the Society until such time as the Society may require him to pay his dues.

3 The young foreign student engineer who is in this country for one year may be permitted to pay the dues of a Student Member in order to have the privilege of receiving MECHANICAL ENGINEERING and attending meetings during his residence in the United States.

1953 Awards

On recommendation of the Board on Honors the following additional awards for 1953 were approved:

Machine-Tool Design and Economic Value Awards:

First Award—Ernest Wildhaber, Fellow ASME, Rochester, N. Y., for his paper, "Manufacture and Application of Gleason Toothed-Face Couplings and Clutches."

Second Award—Robert R. Slaymaker, Mem. ASME, Cleveland, Ohio, for his paper, "Bearing Design Using Concentric Journal Theory."

Third Award—Carroll R. Alden, Mem. ASME, Detroit, Mich., for his paper, "Electro-Spark Machining."

Charles T. Main Award to Peter Ashurkoff, Cambridge, Mass., for his paper, "The Engineer's Contribution to the Increase in the Standard of Living."

Postgraduate Student Award to George Leppert, Dayton, Ohio, for his paper, "A Stable Numerical Solution for Transient Heat Flow."

Undergraduate Student Award to Robert M. Bell, Manchester, England, for his paper, "The Sixty-Inch Vertical Boring and Turning Mill."

Joint Combustion Conference

On recommendation of the Board on Technology, it was voted to invite The Institution of Mechanical Engineers to participate in the planning and conduct of a Joint Conference on Combustion to be held in Boston, Mass., June 15–17, 1955, as part of the ASME 75th Anniversary celebration. IME would take responsibility for organizing participation by European scientists in all fields of combustion and ASME would organize similar participation in North America. It was voted to extend a cordial invitation to Prof. O. A. Saunders, member of the Council of IME, to participate in the 1953 Annual Meeting as a representative of the Institution. His visit will permit an opportunity to work out plans for the Conference.

The Committee also authorized the Board on Technology to organize a committee to be responsible for North American participation in the Conference.

IRD Division

The Committee approved the change in name of the Industrial Instruments and Regulators Division to the Instruments and Regulators Division.

Lectureship Committee

The following procedure for the lectureship activity was approved:

1 Survey the Sections, through the Regional Vice-Presidents (and at its discretion, extend the survey to other channels), to determine the type of lecture desired.

2 Survey the membership, to determine therefrom those having the special qualifications for leadership by lectures in the field of mechanical engineering.

3 Determine the policy to be followed by the Director of Lectureships and the procedures to be followed by him, modifying them from time to time as may become necessary or expedient.

4 Report to the Board on Technology annually on the results obtained, naming the lecturers and their subjects, as well as the locations and times of delivery, together with recommendations as to which lectures, if any, should be honored at the ASME Annual Meeting by mention on the program and the receipt of Certificates as "ASME Lecturers."

5 Present annually to the Board on Technology the ASME Lectureship Budget for the following year.

Towne Lecture

It was reported that the Henry R. Towne Lecture at the 1953 Annual Meeting will be delivered by Philip M. McKenna, president, Kennametal, Inc., Latrobe, Pa. Mr. McKenna is also the 1953 recipient of the Holley Medal.

Free-Coupon Policy

The Secretary reported that in a period of approximately six weeks, ending September 30, after the issue of the free coupons to members, 725 members sent in coupons for 2909 papers of which 467, or 16 per cent, were unavailable. The reasons for unavailability were (1) the stock was exhausted or (2) the papers had not been printed.

Research Contracts

The Committee noted the following extensions of research agreements for the record:

Battelle Memorial Institute—(*a*) Survey of High-Temperature Properties of Chromium-Molybdenum Steels and Super Alloys—to be continued until Oct. 31, 1954, with an additional appropriation of $3000; (*b*) Determination of the Effect of Notches on the Fatigue Properties of N-155 Alloy—to be continued until April 30, 1954, with an additional appropriation of $2000. The Committee also approved a contract with Engineering Research Institute, University of Michigan, covering Compilation of Relaxation Data for a term extending from Sept. 1, 1953, to Sept. 1, 1954.

Sections

The establishment of an ASME Group at Shreveport, La., was approved. It will include the following parishes: Miller, Lafayette, Columbia, Union, Calhoun, Quachita, Nevada, Hempstead County in Arkansas, De Sota, Red River, Bienville, Claiborne, Webster, Bossier, and Caddo in Louisiana.

Group status was also approved for Amarillo, Texas. The following counties are assigned: Cimarron, Texas, and Beaver Counties in Oklahoma, Deaf Smith, Randall, Armstrong, Donley, Collingsworth, and all the counties north thereof in Texas.

The Committee authorized the establishment of the Hawaii Section.

E. S. Theiss, vice-president Region V, advised the Committee that disbandment of the Peninsula Section will become effective 60 days from Oct. 6, 1953.

Regional Delegates Conference

The recommendations of the 1953 Regional Delegates Conference, submitted to the Council in June, have been referred to the Committees concerned for comment and action. It is hoped to be able to report on these actions at the Council meeting in November, 1953.

Paul B. Eaton

The resignation of Paul B. Eaton, director at large, whose term expires in 1955, was accepted. Professor Eaton is now in Formosa as a member of the Mutual Security Agency.

Annual Meeting

In connection with the 1953 Annual Meeting, it was voted to convene official representatives of the Professional Divisions with the Council on Sunday evening, November 29, to discuss questions raised by the Divisions.

1954 Power Show

The Committee approved a procedure for the 1954 Power Show.

Certificates of Award

Various certificates of award were granted to retiring officers of Sections and Regional committees.

John F. Blackburn

The Committee approved a certificate of award to John F. Blackburn for his five technical papers presented at the Annual and other meetings of the Society on "Contributions to Hydraulic Control."

Charles M. Pond

The Committee granted a certificate of award to Charles M. Pond, vice-president, Pratt and Whitney Division, Niles, Bement, Pond Company, West Hartford, Conn., for his "devoted and untiring efforts in the development of standards for the metalworking industries."

IME Clayton Lecture

The Committee approved the acceptance by Frederick S. Mallette, executive secretary of the ASME Committee on Air Pollution Controls, of an invitation from The Institution of Mechanical Engineers to deliver a James Clayton paper in London, England, April 23, 1954.

Employment Conditions

Upon recommendation of Engineers Joint Council, the Committee authorized the President and the Secretary to circulate a questionnaire to the members of ASME to secure information about members' opinions on employment conditions.

New EJC Committee

It was voted to appoint an ASME representative on the newly formed Committee on Recognition of Fields of Engineering Specialization of Engineers Joint Council. The committee will limit its activity to those fields of specialization which involve the activities of more than one of the constituent societies of EJC.

Panel on Abstracting Services

C. E. Davies was appointed representative pro-tem of the ASME on the Engineers Joint Council panel on abstracting services for engineering literature.

ECPD

Each year the ASME representatives on the Engineers' Council for Professional Development submit a report at the ECPD Annual Meeting. The Committee confirmed letter-ballot approval of the 1953 report made to ECPD.

Engineering Societies Building

The President was authorized to appoint a committee of three to serve as ASME representatives with representatives of the other societies concerned in a fund-raising effort for a new engineering societies building.

Verein Deutscher Ingenieure

A communication was reported from the Verein Deutscher Ingenieure, Dusseldorf, Germany, in which the Verein explained its plan to send official representatives to visit the United States and become acquainted with other engineering groups and with industry. The Committee voted to extend a cordial invitation to the delegation of the Verein to visit the United States during the time of the ASME Annual Meeting, Nov. 30–Dec. 4, 1953.

Creative Frontiers TV Program

Creative Frontiers is incorporated under the laws of New York State for developing a television program entitled Creative Frontiers. It will act as liaison between the producers and the societies for collecting and disseminating the information gathered for television programs by the various specialized societies. The following men have been appointed to represent the ASME on the program: W. H. Larkin, H. C. R. Carlson, and G. W. Nigh.

Mutual Security Agency

The Mutual Security Agency has presented the ASME with a certificate to express its "appreciation and thanks for the wholehearted co-operation, hospitality, and unselfish giving of your time and experience to the United Kingdom Industrial Engineering Group who completed their visit in America in March, 1953."

Arthur M. Greene, Jr.

The Secretary reported with deep regret the death, on Sept. 2, 1953, of Arthur M. Greene,

Jr., Hon. Mem. ASME, manager, 1913–1916, and vice-president, 1916–1918.

Appointments

The appointments on Boards, Committees, and Joint Activities recommended by the Organization Committee were reviewed and approved.

Presidential Appointments

The following presidential appointments were confirmed:

Frank L. Schwartz to inauguration of president, Wayne University, Detroit, Mich., Nov. 9, 1953.

W. G. Christy, H. V. Coes, and H. B. Oatley as Tellers of Election of 1954 Officers.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Plant or Maintenance Engineer, 41, married, ME, production, tooling, maintenance valve manufacturing; plant engineer, metal stamping, forming, painting, assembly plant. Design, construction experience, ventilating, air conditioning. Available in 30 days. Prefers Southern California. Me-27-5310-D-1. San Francisco.

Mechanical Engineer, 31, married, BS. Three honor societies. Registered. Nine years' experience; four years piping, refrigeration, heating, air handling, etc., design for process industry; three years general oil-field construction. Desires position with consulting firm. Four weeks' notice. Prefers metropolitan location. Me-28-5310-D-8. San Francisco.

Mechanical Engineer, three years' manufacturing and assembly experience in production of small precision mechanisms. Desires position as assistant project or production engineer with medium-sized company. Location open. Me-29.

Manufacturing-Process Engineer, 31, several years' experience manufacturing methods, operation-sheet writing, machine-tool and gage specification, engineering liaison, machine-shop knowledge. Desires to progressively acquire management experience. East. Me-30.

Mechanical and Electrical Engineer, Harvard Business graduate, registered, 48, experienced in process industries and in development, manufacture, application, and administration in fine mechanical and instrument field (including electronics). Prefers Philadelphia. Me-31.

Mechanical Engineer, BME, MS in applied mathematics, PE(NY), 28, veteran, five years' experience in stress analysis, general analysis, and materials co-ordination, two years in charge of section. Prefers New York area. Me-32.

Sales Engineer, 11 years' experience both light and heavy metalworking; production, development, equipment; plant visits, meet people all ranks; trouble-shooting; advise improvements; sales correspondence; co-ordinate projects; BSME, Lehigh. Me-33.

Mechanical Engineer, 37, BSME, N. Y. license 15 years present employer. Desires eastern relocation, responsible position design-development light to medium product. Experience covers mechanisms, metal parts, plastics, die castings. Me-34.

Fire-Protection Engineer, BME, four years' experience in fire protection: sprinklers, fire alarm, plant-fire departments, and water supply. Willing to travel. Cognizant of cost of fire protection as well as fire loss. Metropolitan New York area. Me-35.

Positions Available

Production Engineer, 30–35, degree in engineering and preferably three to five years' experience in time study and wage-rate setting, capable of taking charge of industrial-engineering department. Work involves the supervision of four time-study men and two clerks. The department conducts time and motion studies in various wage jobs, establishes incentive as well as day-work rates. Should be capable of progressing into other phases of production management. Must be willing to be transferred to various plants of the company. $5000–$6000. Mass. Y-9249.

Assistant or Associate Professor, MS in ME, to teach graduate and undergraduate courses in thermodynamics, heat power, and supervise laboratory courses. $5000–$6000, nine-month basis. New York metropolitan area. Y-9289.

Industrial Engineer, 40–45, planning, production, marketing, budget, and general administrative experience in textile or allied organizations. $20,000–$25,000, plus bonus. New York, N. Y. Y-9290.

Engineers. (*a*) Development engineers, preferably mechanical or electrical-engineering degrees, or technical background equivalent to at least two years of formal education. Duties will consist of development engineering work on new product lines, devising manufacturing methods and techniques in metal forming, welding, soldering, and assembly. Should be able to express ideas by means of sketches and follow through with craftsmen, mechanics, and production people in putting these ideas into effect, giving instructions as may be required. (*b*) Machine designer, technical education and three to five years' experience on design of light machinery. Duties will be mostly drawing-board work, designing machinery for the manufacture of flexible metallic hose. Will be required to lay out complete designs from requirements, make engineering contacts with buyers on purchased components. Salaries open. Conn. Y-9293.

Chief Engineer, 35–45, capable of directing machine-tool design, jig and fixture design, tooling design. Research and development on grinding machines. Administrative ability, machine-shop experience, and an appreciation of costs of manufacture. $6000–$15,000, depending on experience. New England. Y-9311.

Chief Design Engineer, extensive knowledge of intricate design and research methods. Should have over ten years' experience in the practical application of engineering principles to the development of intricate precision mechanisms required to gain and develop the background necessary to handle all of the facets of the design problems of the varied design groups. Experience in co-ordinating the work of engineering personnel necessary. Ill. Y-9312.

Sales Engineer, 30–40, mechanical or metallurgical training, machinery and sales experience covering steel tubing for importer. $6000–$8000, plus bonus. New York, N. Y. Y-9313.

Administrative Engineers, 35–40, technical degree desired. Must have shop supervisory experience. Prefer one with apprenticeship background and practical experience in tooling, machining, stamping, brazing, and assembly operations. Positions are in training for assistant works-manager assignments. $7500, and up. East and Midwest. Y-9319-D-8904.

Vice-President to head up engineering and sales of company engaged in the manufacture and sale of gages and gage devices to control automatic machine tools, particularly grinding tools. Salary open. New York, N. Y. Y-9320.

Test Engineer, mechanical or electrical graduate, at least five years' laboratory and production-test experience on electromechanical devices. $6000. Brooklyn, N. Y. Y-9323(*b*).

Mechanical Designer-Draftsman to design and prepare layouts for heating, ventilating, and air-conditioning systems for buildings, including schools, churches, hospitals, office buildings, institutional and public buildings, etc. $5200–$6500. Va. Y-9331.

Project Engineer, mechanical graduate, at least five years' chemical-equipment design, layout and pilot-plant-installation experience covering process equipment for plastic producer. $6500–$9000. Northern N. J. Y-9333.

Chief Engineer, PhD in mechanical engineering, 35–45, strong background or experience necessary both in general physics and mechanical design in order to be able not only to direct the design of equipment, but also to make the fundamental analysis of the problems involved. About $18,000. Texas. Y-9335(*a*).

General Manager, 40–50, mechanical or electrical graduate, sales experience in industrial-instrument controls or allied fields. $10,000, plus bonus. Midwest. Y-9346.

Methods Engineer, at least ten years' experience in jobbing machine-shop fields for operation-sheet writing, cost analysis, etc., for aircraft-parts producer. $6500. Queens, N. Y. Y-9348.

Mechanical Engineer, under 30, plant engineering, methods, and layout experience covering coil-winding machinery and assembling equipment on electromechanical devices. $5400–$6000. N. C. Y-9349.

Plant Manager, 38–49, for plant employing 700, manufacturing precision automatic machinery. Proved administrative ability in metalworking job shop essential. Reports to divisional manager. $12,000–$14,000. New York, N. Y. Y-9350.

Research and Development Project Engineers for directing projects in jet-nozzle and burner-can developments. Must have general knowledge of jet-engine construction and characteristics, be familiar with the jet-engine fuel-control system, and have a practical and theoretical knowledge of jet-engine fuel-nozzle-can characteristics and their requirements. Upstate N. Y. Y-9351.

Project Production Engineer, up to 50, at least five years' experience in practical apparatus-production work. Familiar with precision machine tools, foundry and die casting, plastic molding, and assembly operations. Will make engineering design and models of electrical, optical, and electromechanical devices for production. Will be "buffer" between engineering and production departments for manufacturer of instruments. $6000, and up. Colo. C-1363.

Tool Engineer, up to 50, two years' experience in tool and die, experience in roll-forming and end-forming dies for metal moldings. Knowledge of stainless steel and aluminum helpful. Will design end-forming and roll-forming dies for a manufacturer. $7200–$9600. Employer will negotiate placement fee. Ill. C-1383.

Plant-Maintenance Engineer, up to 45, mechanical, ten years' experience in general plant engineering and preferably in textiles and/or rubber industry. Knowledge of heavy machinery. Will be assistant plant engineer for textile and rubber-working plant, for a felt manufacturer. $9000. Employer will pay half of placement fee. Ill. C-1392.

[1] All men listed hold some form of ASME membership.

Works Manager, 35–50, five years' experience in forging of agricultural shapes or sheet-metal furnaces and incinerators. Knowledge of labor negotiations. Will supervise all operations for manufacturer of farm and sheet-metal products and special machinery manufacturing for a manufacturer of agricultural equipment. $10,000–$15,000. Employer will pay fee. Ill. C-1393.

Sales Engineer, mechanical or electrical, up to 30, at least two years' experience in sales or application of electrical equipment. Knowledge of mechanical power transmission and electronic circuitry. Will sell a line of electrical clutches and power transmissions, variable drives, and electronic speed controls. Training position to district manager for a manufacturer of transmission equipment. $4800–$6000, plus commission and expenses. Employer may negotiate placement fee. Wis. C-1394.

Operations Superintendent, graduate, some experience in mechanical, electrical, metallurgical, general machine, grinding, tool and die, inspection and testing. Will process small castings by grinding, die casting, swaging, rolling, drawing, drilling and tapping inserts, cleaning, inspecting, testing, packing and shipping, personnel, scheduling, time study, and quality control. $6000, and up. Ill. C-1395(*a*).

Aircraft-Armament Designer, engineering degree, five years' experience in aircraft-armament work. Duties involve that of staff specialist in the design of aircraft armament and installation, including evaluation of armament systems; preparation of specifications; and directing testing for a manufacturer of airplanes. $12,000–$14,000. Texas. C-1408.

Engineering Supervisor, 30–50, engineering degree, five years' experience in electromagnetic controls in high-volume production and preferably two years in supervisory capacity. Knowledge of manufacturing operations and finishes. Will supervise product performance affected by design changes at request of manufacturing department, for a manufacturer of gas appliances. $7200–$9000. Employer will pay placement fee. Wis. C-1409.

Industrial Engineer, up to 37, industrial or mechanical degree, at least two years' experience in time study or methods work. Training position for top production supervisory positions for a manufacturer of building materials. Up to $6000. Employer will negotiate placement fee. Ill. C-1418.

Chief Engineer, 40–55, three years' experience in hydraulic (oil) pump design or development work. Will supervise design of new pumps and improve old design to combine sales appeal, utility, and low manufacturing costs; design of tools, gages, and fixture cost estimating; and improve materials and methods for manufacturer of pumps. $9000–$10,000. Employer will pay one half of placement fee. Ill. C-1420.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Dec. 24, 1953, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

NEW APPLICATIONS

For Member, Associate, or Junior

ACKLAND, JOHN M., London, England
ALDAMIZ, JOSE M., Bilbao, Spain
ALPER, STANLEY, Schenectady, N. Y.
BARCLAY, THOMAS D., JR., North Wales, Pa.
BARTOLINA, EDWARD A., Tulsa, Okla.
BLACK, ALBERT C., Terrace Park, Ohio
BOATMAN, BERNARD O., Chicago, Ill.
BONNAPE, OLIVER W., Hudson, Mass.
BORDMAN, SANFORD L., New Haven, Conn.
BRADLEY, EDWARD L., Glenview, Ill.
BRUSH, JOHN B., Ivorydale, Ohio
BURGGRABE, WILLIAM F., University City, Mo.
BURNETT, CHARLES E., Maryville, Tenn.
BUSNEKELL, CHARLES C., North Hollywood, Calif.
CAMPBELL, JOSIAH C., JR., Chattanooga, Tenn.
CARMICHAEL, ROSCOE W., Texas City, Texas
CHANT, RAYMOND E., Winnipeg, Man., Can.
CHENEY, NORMAN E., North Weymouth, Mass.
COCHRAN, CHRIS S., North Canton, Ohio
COTHREN, JACK, Schenectady, N. Y.
COUNCIL, THURMAN F., Charlotte, N. C.
COUNTESS, JAMES E., Baltimore, Md.
CUNNINGHAM, DON M., Berkeley, Calif.
DAMM, VICTOR W., Niles, Mich.
DOW, RICHARD B., Arlington, Va.
FELDMAN, KARL T., Independence, Kan.
FERNS, GERARD S., Belleville, N. J.
FURLOW, JOHN W., Philadelphia, Pa.
GIESECKE, FREDERICK A., Riverside, Ill.
GONZALEZ-ARECHIGA, JUAN A., Cleveland, Ohio
GOULD, CHARLES D., Seattle, Wash.
GREEN, JOHN M., Ames, Iowa
HAGEMANN, ROBERT G., Longmeadow, Mass.
HILL, VERNON J., JR., Bristol, Tenn.
HINDLE, ROBERT A., Reading, Pa.
HOCTOR, JAMES J., JR., Cincinnati, Ohio
HOLST, GUSTAVE E., West Townsend, Mass.
HORTON, EARL A., Philadelphia, Pa.
HUBBARD, ARTHUR P., Moline, Ill.
JENKINS, HAROLD B., Cincinnati, Ohio
JENSEN, ROBERT E., Los Alamos, N. Mex.
JOHNSTON, JAMES H., Moylan, Pa.
KEMP, NEAL J., JR., Detroit, Mich.
KROESCHELL, THOMAS R., Wilmette, Ill.
KRONENBERG, MAX, Cincinnati, Ohio
KWIATKOWSKI, JOSEPH N., Washington, D. C.
LANDIS, FRED, New York, N. Y.
LANDO, FREDERICK, New York, N. Y.
LANNAN, JOSEPH G., JR., Wollaston, Mass.
LARSEN, LAWRENCE, JR., Cincinnati, Ohio
LAWLESS, DON R., Elkhart, Kan.
LAWSON, WILBUR D., Mt. Kisco, N. Y.
LEESE, SYDNEY E., Detroit, Mich.
LINTON, PETER, Harlow, Essex, England
LOEB, WILLIAM A., Hartsdale, N. Y.
LONDON, MAURICE, Brooklyn, N. Y.
LUBINSKI, ARTHUR, Tulsa, Okla.
MAGLEY, FLOYD L., Levittown, N. Y.
MALONEY, NORVIN G., Wilmington, Del.
MARTIN, JOHN F., Hartford, Conn.
MAXSON, DALE E., Milwaukee, Wis.
McALLISTER, CHARLES H., Honolulu, T. H.
McCLINTOCK, GEORGE A., Houston, Texas
McGARVEY, EUGENE F., Philadelphia, Pa.
MEWSE, FREDERICK, Danbury, Conn.
MEYERS, EARL J., Wilmington, Del.
MILLER, JOHN J., JR., Midland, Mich.
MILLIKEN, ARNOLD W., Binghamton, N. Y.
MITCHELL, JOHN W., Charleston, W. Va.
MONACELLI, GUIDO, Detroit, Mich.
MUELLER, WHEELER K., JR., Bronx, N. Y.
NARAYANAN, SUBRAHMANYA, Madras, India
PACINI, ELMO J., Arlington, Mass.
PASQUA, FRANK, JR., Pitman, N. J.
PENICK, STUART T., Doylestown, Pa.
PERRY, EDWARD F., Strathmore, Que., Can.
PETERSON, ROY S., Richland, Wash.
PETREE, J. FOSTER, Sutton, Surrey, England
PLANSTROM, JOHN T., New York, N. Y.
PORTER, JAMES A., Maracaibo, Venezuela, S. A.
POWELL, ORLO A., JR., Cambridge, Mass.
QUAYLE, GEORGE F., Philadelphia, Pa.
QUINLAN, EUGENE T., Detroit, Mich.
QUINN, JAMES D., Warwick, Md.
REAY, ROBERT P. S., Brooklyn, N. Y.
REESE, JOHN P., Kansas City, Mo.
REID, WILLIAM T., JR., Peoria, Ill.
RICHARD, JOHN J., Morgantown, W. Va.
RIEKE, ROLF E., Farmingdale, L. I., N. Y.
ROBBINS, WALTER A., SR., Danville, Va.
ROMAN, JORDAN B., Richmond, Va.
ROSS, ROBERT E., Minneapolis, Minn.
RUDDLE, THOMAS H., Detroit, Mich.
SCHMIDT, FRANK W., Philadelphia, Pa.
SCHMIDT, ROBERT R., North Hollywood, Calif.
SCHOFIELD, EDMUND, Oaklawn, Ill.
SCHOTTES, RICHARD W., Albuquerque, N. Mex.
SCHULZE, JOHN J., Prospect Heights, Ill.
SHAKESHAFT, HAROLD L., JR., Jonesville, N. Y.
SHAMIS, GEORGE E., Allentown, Pa.
SHARPE, HENRY D., JR., Providence, R. I.
SMITH, THOMAS M., Kingsport, Tenn.
SPANGLER, WILLIAM H., Hollsopple, Pa.
SPEAR, ALEXANDER, Newburgh, N. Y.
SPENCER, ROBERT A., Richmond, Va.
STRONKS, ROBERT G., Culver City, Calif.
SUTTER, FREDERICK K., Greensburg, Pa.
THACKER, MILTON B., Salt Lake City, Utah
TORDA, THOR P., Urbana, Ill.
VARTANIAN, VARTAN, Pawtucket, R. I.
WADDELL, MUNCEY E., Albany, N. Y.
WEAVER, WILLIAM R., Canton, Ohio
WHEELER, EDWARD H., Ambler, Pa.
WHITE, ROGER F., Riverdale, N. J.
WHITING, MACAULEY, Midland, Mich.
WHITNEY, PETER H., Harborcreek, Pa.
WIDMONT, JOSEPH C., JR., Pasadena, Calif.
WILDI, PAUL, Tacoma, Wash.
WISE, JOHN L., Reading, Pa.
WOJTAS, GUSTAVE, JR., Des Plaines, Ill.

CHANGE IN GRADING

Transfers to Member and Associate

AST, JOHN H., Cleveland, Ohio
BANKSON, E. EDWIN, Pittsburgh, Pa.
BAUM, RICHARD T., White Plains, N. Y.
BEARDSLEY, EDWARD G., Olean, N. Y.
CARLSON, HARRY W., North Woodbury, Conn.
CERNIGLIA, ANTHONY T., New York, N. Y.
COVINGTON, WAYNE R., Seattle, Wash.
ERDMAN, FRANCIS H., Richmond, Va.
FIEDLER, FRED S., Burbank, Calif.
GANS, CARL, New York, N. Y.
GOLDEN, GENE E., Scranton, Pa.
GROSCHOFF, ERNST H., Glen Head, N. Y.
GROSSMAN, PAUL R., Alliance, Ohio
HERING, HAROLD E., Cicero, Ill.
HOGLUND, GUSTAV O., New Kensington, Pa.
HUBER, ALFRED L., Florham Park, N. J.
JESATKO, STANLEY J., Pearisburg, Va.
LONGSTRETH, MURREY O., Midland, Mich.
MARSHALL, THOMAS H., JR., Baltimore, Md.
MICHAELS, ROBERT K., Orlando, Fla.
MILLER, ROBERT P., Kansas City, Mo.
MONROE, ELMER S., JR., Ithaca, N. Y.
MORRO, JOHN J., Bridgeport, Conn.
NELSON, MILLARD A., Philadelphia, Pa.
NORDQUIST, WILLIAM B., Seattle, Wash.
NUNNELEE, HAROLD B., West Allis, Wis.
PERRY, ROBERT W., Tullahoma, Tenn.
RAUB, ARTHUR L., JR., Palmerton, Pa.
SHEETS, TED C., Toledo, Ohio
TURNER, THEODORE S., Bridgeport, Conn.
VAN WYLEN, GORDON J., Ann Arbor, Mich.
VITOLO, ROBERT A., East Rockaway, N. Y.
WALKER, CHARLES W., Lompoc, Calif.
WENIG, HAROLD G., Flushing, N. Y.
WIENER, MAX, Irvington, N. J.
WILLIAMS, RICHARD F., Wyandotte, Mich.

Transfers from Student Member to Junior.....10

Obituaries

Charles Elmer Barba (1877–1953)

CHARLES E. BARBA, designing engineer, The Franklin Institute, Philadelphia, Pa., consulting engineer and lecturer on railroads, died Sept. 5, 1953. Born, Freemansburg, Pa., May 12, 1877. Parents, William H. and Christiana (Smith) Barba. Education, ME, Lehigh University, 1901. Married Margarita E. Dunn, 1904; children, Charles E., Jr., St. Louis, Mo.; Margarita C. (Mrs. William E.) Hopkins, Newton, Mass.; Dorothy A. (Mrs. Bernard) Wefers, Tuckahoe, N. Y.; Preston A., St. Louis; Francis W., West Alexander, Pa.; Col. William H., USMC, Vista, Calif.; Elizabeth D. (Mrs. Ashley E.) Stetson, San Raphael, Calif.; Robert E., Alexandria, Va.; John E., Elkton, Md. Mem. ASME, 1944. He served the Society as chairman, Railroad Division. Author of several articles and technical papers and held many patents on railway cars and equipment.

Webster Lance Benham (1882–1952)

WEBSTER L. BENHAM, senior partner, Benham Engineering Co., Oklahoma City, Okla., died in November of 1952, according to a notice recently received by the Society. Born, Fort Snelling, Minn., April 16, 1882. Parents, Brig-Gen. Webster Benham, USA, and Kate (Fitzhugh) Benham. Education, graduate, Trinity School, New York, N. Y., 1901, valedictorian, awarded McVickar prize for scholarship, and J. Pierpont Morgan Scholarship at Columbia University, graduate, CE, 1905. Married Margaret L. Drake, 1908; children, Margaret K., Webster L., Jr., David B., John F. Mem. ASME, 1950. Author of numerous articles published in technical journals. Received Award of Merit from the American Association of Engineers for most distinguished service rendered to the profession and community during 1924. He also received many other honors and awards.

Joseph F. Carney (1869–1953)

JOSEPH F. CARNEY, consulting engineer in the planning of the Waldorf-Astoria Hotel and its building superintendent from 1931 until his retirement in 1949, died Sept. 30, 1953. Born, New York, N. Y., Dec 3, 1869. Parents, John and Johanna (McCarthy) Carney. Education,

(*ASME News continued on page 1050*)

new WIDER VISION

for easier remote boiler water level readings

■ Vastly improved visibility of remote boiler water level readings can now be enjoyed by boiler plant operators.

A new "wide vision" face on Yarway Remote Liquid Level Indicators allows reading from the side as well as front of the indicator. Boiler water levels and other liquid levels can be checked from most any position.

Indicating mechanism is operated by the boiler water level itself—assuring instant, accurate readings.

Yarway Indicators are of the manometric type with automatic temperature compensation, as approved for use under the recent A.S.M.E. Boiler Code Committee ruling in Case # 1155.

Over 10,000 are used throughout industry for boiler water and other liquid level indication . . . and for superheater pressure differential indication aboard ship.

For full information write for Bulletin WG-1823.

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Besides Remote Liquid Level Indicators, Yarway also offers Liquid Level Recorders and Remote Signal Alarms . . . making a complete system for constant, accurate liquid level check.

■ Yarway Hi-Lo-Graph Recorder provides not only water level indication, but also a 24-hour recording of water levels. See Yarway Bulletin WG-1830.

■ Yarway Remote Hi-Lo-Alarm Signals—lights or horns—can be placed at any location in plant. See Yarway Bulletin WG-1823.

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attended the common school. Married Kathryn Kerrigan (died 1946). In 1940 he received the Robert Grimshaw Medal for outstanding work in engineering. Mem. ASME, 1950. He was a member of the National Association of Power Engineers for 60 years and its president in 1910. He was also a charter member of the Metropolitan Section of ASME and of ASPE. Survived by two sons, Joseph F. and Arthur.

Remey M. Cox, Jr. (1927–1953)

REMEY M. COX, JR., warehouseman, Standard Oil Co. of California, Kendall Branch, Portland, Ore., died July 25, 1953. Born, Bend, Ore., April 2, 1927. Education, BS(ME), Oregon State College, 1949. Jun. ASME, 1949.

Serban Theodore Drutzu (1894–1953)

S. T. DRUTZU, rate engineer, Ebasco International Corp., New York, N. Y., died July 9, 1953. Born, Galatz, Rumania, July 15, 1894. Parents, Charles D. and Anna (Nenitzesco) Drutzu. Education, BA, State College, Focshani, Rumania, 1911; ME, K. K. Technische Hochscule, Charlottenburg, Germany, 1916; MA, Columbia University, 1928. Naturalized U. S. citizen, Bronx, N. Y., 1931. Married Louise H. Dupuy, 1921; daughter, Anne Marie. Assoc-Mem. ASME, 1921; Mem. ASME, 1935. He was the author of several technical papers.

Ira Willard Dye (1886–1953)

IRA W. DYE, design engineer, Birch-Johnson-Lytel Co., Seattle, Wash., died Aug. 12, 1953. Born, Sabetha, Kan., Jan. 17, 1886. Parents, Ira B. and Tillie Luella (Wolcott) Dye. Education, graduate, Nebraska State Normal School, 1903; BS(EE), University of Nebraska, 1912. Married Helen M. Stonecypher, 1910; children, Ira, 4th; David L. Assoc-Mem. ASME, 1913; Mem. ASME, 1935. He received the Panama Canal-Roosevelt Medal, 1916.

Lewis Martin Ellison (1866–1953)

LEWIS M. ELLISON, president, Ellison Draft Gage Co., Chicago, Ill., died July 4, 1953. Born, Waupaca, Wis., April 11, 1866. Education, high-school graduate. Assoc. ASME, 1911; Mem. ASME, 1913.

John C. Estes (1917–1953)

JOHN C. ESTES, senior engineer, General Electric Co., Richland, Wash., died in Tillimook, Ore., August, 1953. Born, Los Angeles, Calif., Jan. 17, 1917. Parents, Clifford S. and Lenore Estes. Education, University of California Extension, Berkeley; 3½ years ME credit, University of Southern California, Los Angeles, 1939; associate arts., Santa Monica City College. Married Charlotte R. Estes, 1949. Mem. ASME, 1951. Survived by wife; two children, by previous marriage, Jean A., Nancy L.; and his mother.

Arthur Maurice Greene, Jr. (1872–1953)

ARTHUR M. GREENE, JR., dean-emeritus, school of engineering, Princeton University, died Sept. 2, 1953. Born, Philadelphia, Pa., Feb. 4, 1872. Parents, Arthur M. and Eleanor J. (Lowry) Greene. Education, BS, University of Pennsylvania, 1893; ME, 1894; studied in Germany, summers, 1896 and 1905; hon. DS, 1917; hon. DE, Rensselaer Polytechnic Institute, 1922; hon. LLD, University of Missouri, 1940. Married Mary Elizabeth Lewis, 1906 (died 1949). Consultant engineer for power plants and manufacturing; expert in patent causes; consultant to Co-ordinator of Inter-American Affairs; consultant to chairman, War Production Board, February–June, 1942. Expert consultant, Army Specialized Training Division, United States Army. Mem. World Power Conference, 1930 and 1936. Mem. National Research Council (engineering division); chairman, power-plant committee, United States Fuel Administration, for Rensselaer County, N. Y.; mem. engineering council, War Committee of Technical Societies. Mem. Governor's Highway Council of New Jersey; mem. New Jersey State Board of Professional Engineers and Land Surveyors. Jun. ASME, 1895; Mem., 1903; Fellow ASME, 1936; Hon. Mem. ASME, 1940. He served the Society as Manager, 1913–1916; Vice-President, 1916–1918; chairman, Research Committee; mem. Boiler Code Committee (chmn. number of subcommittees); chairman, Committee on Awards. He was also a member of the American Society for Engineering Education (president, 1919–1920); Society of Engineers, Eastern New York (ex-president); American Engineering Council; Princeton Engineering Association (hon.); Newcomen Society, Guild of Brackett Lecturers of Princeton University; and many other honorary and educational societies. He had recently completed the history of the ASME Boiler Code, eight chapters of which were published in MECHANICAL ENGINEERING. He was the author of several textbooks which are today widely used in the teaching of engineering. See editorial entitled, "Arthur M. Greene, Jr.," MECHANICAL ENGINEERING, October, 1953, pages 773–776.

Elmer Lisle Hughes, Sr. (1895–1953)

ELMER L. HUGHES, SR., founder and senior partner, Hughes Machinery Co., Kansas City, Mo., died May 6, 1953. Born, Cortland, N. Y., Feb. 25, 1895. Parents, Lisle C. and Martha (Reynolds) Hughes. Education, BS(ME), Washington University, 1917. Married Agnes Manley, 1918. Mem. ASME, 1944. He served the Society as chairman, Kansas City Section. He was a past-president of the Engineers' Club of Kansas City. Survived by wife, son, Elmer L., Jr., Jun. ASME; and his mother.

Harry B. Joyce (1889–1953)

HARRY B. JOYCE, consulting engineer, specialist in the design of complete power plants including steam and electric systems, Erie, Pa., died Aug. 21, 1953. Born, Baltimore, Md., Feb. 25, 1889. Parents, Harry S. and Catherine Joyce. Education, graduate Baltimore Polytechnic Institute, 1907; BS(ME), Cornell University, 1911; EE, 1912. Married Mabel E. Shell, 1925; daughter, Phyllis Joyce. Mem. ASME, 1931; Fellow ASME, 1951. He twice served the Society on national meeting committees. His more recent participation was in 1949, when the ASME Fall Meeting was held in Erie. For 10 years he served on the Pennsylvania State Board of Examiners for Professional Engineers.

Grover Keeth (1884–1953)

GROVER KEETH, chief power engineer, Marathone Paper Mills Co., Rothchild, Wis., died June 26, 1953. Born, Spencerville, Ohio, Sept. 8, 1884. Parents, Francis M. and Jennie Keeth. Education, BS(ME), Armour Institute of Technology, 1906; ME, 1910. Married Alice Sawtell, 1913. Mem. ASME, 1925; Fellow ASME, 1948. Mr. Keeth was a consultant to several companies and was widely known as a power engineer in the papermaking industry, having at one time served as president of the American Pulp and Paper Mill Superintendents' Association. He was also affiliated with the American Chemical Society, the National Society of Professional Engineers, and the Engineers' Society of Milwaukee. He served for many years as a member of the Wausau, Wis., water commission. He was a director of the Wisconsin Valley Improvement Co. for a number of years. He was the author of several technical papers on power and maintenance in paper mills and the burning of waste sulphite liquor. Survived by wife, a daughter, Mrs. Charles R. Herms, Arlington, Va.; a brother, J. A. Keeth, Fellow ASME, Kansas City, Mo.; and two grandchildren.

Samuel Leonard Kent, Jr. (1890–1953)

S. LEONARD KENT, JR., consulting engineer, Bryn Mawr, Pa., died Aug. 8, 1953. Born, Burmont, Pa., Feb. 16, 1890. Parents, Samuel L. and Annie (Ahrens) Kent. Education, Episcopal Academy; BS(ME), University of Pennsylvania, 1911; MA(ME), 1928. Married Elizabeth Cryer. Mem. ASME, 1927. Survived by wife and two children, Mrs. E. Shippen Willing, Jr., West Chester, Pa.; and S. Leonard Kent, 3rd, Concord, Mass.

Eugene Wycliff Kerr (1874–1953?)

EUGENE W. KERR, head of firm, E. W. Kerr, Consulting Engineer, Baton Rouge, La., died according to a notice recently received by the Society. Born, McKinney, Texas, Feb. 16, 1874. Parents, J. Lawson and Ophelia (Caskey) Kerr. Education, BS, Texas A&M College, 1896; ME, 1899; special courses at Stevens Institute of Technology and University of Wisconsin; postgraduate work at Purdue University, 1902. Married Rita Sbisa, 1900; children, Eugene J., Janet K. (Mrs. S. T.) Cook, William R. He initiated courses in engineering of sugar manufacture at Lousiana State University; also experimental studies in problems of sugar machinery. He was the author of "Power and Power Transmission" (1902); contributed to various technical magazines; and wrote many bulletins on sugar engineering published by Louisiana State Experimental Station. Jun. ASME, 1902; Mem. ASME, 1908.

Raymond Daniel Lepley (1891–1953)

RAYMOND D. LEPLEY, design adviser, engineering and construction department, The Atlantic Refining Co., Philadelphia, Pa., died Sept. 22, 1953. Born, Cleveland, Ohio, Nov. 8, 1891. Parents, Albert H. and Alice D. Lepley. Education, graduate, Central Manual Training High School, 1909; attended Temple University evening school, 1909–1915. Married Constance Kerr, 1919; children, Constance E., Raymond C., Jane. Mem. ASME, 1941. He was also a member of ASA, API, NACE, and ASTM.

Dudley Maurice Lontz (1903–1953)

DUDLEY M. LONTZ, design engineer, research and development department, The McBee Co., Athens, Ohio, died Sept. 26, 1953. Born, Hagerstown, Ind., Feb. 28, 1903. Parents, Herlie R. and Effie (Fenimore) Lontz. Education ME, University of Cincinnati, 1927. Married Ruth E. Johnson, 1930. Mem. ASME, 1940. He held several patents relating to adding machines and various ordnance designs. Survived by wife and two daughters, Marcia J. and Patricia A.

Arvid Lundquist (1887–1953)

ARVID LUNDQUIST, project engineer, Farrand Optical Co., Inc., New York, N. Y., died Aug. 6, 1953. Born, Falkenberg, Sweden, Aug. 24, 1887. Parents, Peter G. and Hannah Lundquist. Education, ME, Chalmers Technical Institute, Gothenburg, 1911. Naturalized U. S. citizen, New York, N. Y., 1922. Married Maria Pettersson, 1913. Assoc-Mem. ASME, 1920; Mem. ASME, 1935. He was well known as the inventor of numerous patented devices and machines, many especially relating to newspaper-printing presses, which are being used extensively throughout the U.S.A. and other countries. He was president of the American Society of Swedish Engineers, 1945–1948. He was also honorary vice-president of the John Ericsson Society. In 1949 he was decorated by His Majesty the King of Sweden with the Royal Order of Vasa, first class, with the rank of knight, for his outstanding contributions toward good relations between the U. S. A. and Sweden. Survived by wife.

Frank Titus Mahan, Jr. (1923–1953)

FRANK T. MAHAN, JR., research engineer, Engineering Division, Midwest Research Institute, Kansas City, Mo., died Sept. 19, 1953. Born, St. Joseph, Mo., Jan. 8, 1923. Parents, Frank T. and Margaret Rose Mahan. Education, BS(ME), State University of Iowa, 1944. Married Helen N. Fountain, 1946; son, John Frederick. He held several patents relating to ring binders, cooling towers, weapons, and automatic machinery. Jun. ASME, 1944.

Howard Middleton (1900–1953)

HOWARD MIDDLETON, regional manager, Export Division, Nordberg Manufacturing Co., Sydney, N. S. W., Australia, died Sept. 8, 1953. Born, Sydney, Dec. 5, 1900. Education, BE, University of Western Australia, 1924. Mem. ASME, 1947. He was also a member of the Institution of Engineers (Australia) and the Institution of Electrical Engineers (England). He wrote several technical papers on industrial lighting and electrical distribution systems.

John Glenn Mingle (1888–1953)

JOHN G. MINGLE, superintendent, Bureau of Air Pollution Prevention, Board of Public Safety, City of Indianapolis, Ind., died March 29, 1953. Born, Cersco, Mich., Dec. 8, 1888. Education, BS(CE), Purdue University, 1913; CE, 1917. Mem. ASME, 1950. He wrote many articles on chimneys, drafts, and pumping equipment; and a book, "Chimneys." His membership in other professional societies included NAPE, NSPE, and SPAA.

William Stanton Monroe (1868–1953)

WILLIAM S. MONROE, retired engineering executive and a member of the board of trustees of the Illinois Institute of Technology, died at his home in Chicago, Ill., Sept. 12, 1953. Born, Chicago, Aug. 22, 1868. Parents, Henry S. and Martha (Mitchell) Monroe. Education, ME, Cornell University, 1890. Married Anna Hamill Clark, 1898. Jun. ASME, 1898; Mem. ASME, 1901; Fellow ASME, 1941. He was president of the Western Society of Engineers, 1929–1930. He was also a member of ASCE, The Franklin Institute, and many other professional societies. Survived by a son, Henry Monroe, Winnetka, Ill., and three grandchildren.

Clark Tillinghast Morse (1888–1953)

CLARK T. MORSE, president, American Blower Corp., Dearborn, Mich., and Canadian Sirocco Co., Ltd., Windsor, Ont., Can., as well as a director and member, Executive Committee, American Radiator and Standard Sanitary Corp., died Sept. 18, 1953, in London, Ont. Born Evanston, Ill., Dec. 31, 1888. Parents, Charles S. and Hattie (Tillinghast) Morse. Education, attended public schools. Mem. ASME, 1946. For many years he was a leading figure in the air-handling and fluid-drive industries. He was active in civic and charitable organizations, and was recognized as the "father" of the Junior

(*ASME News continued on page 1052*)

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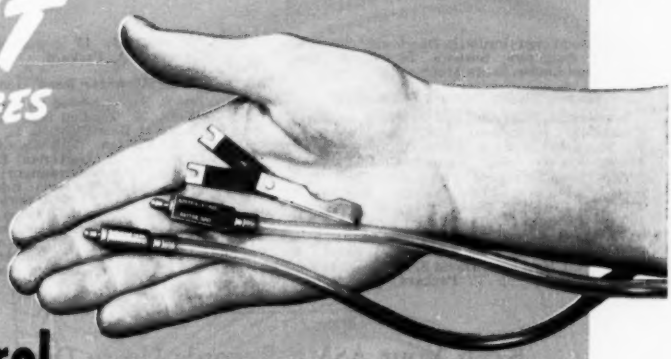
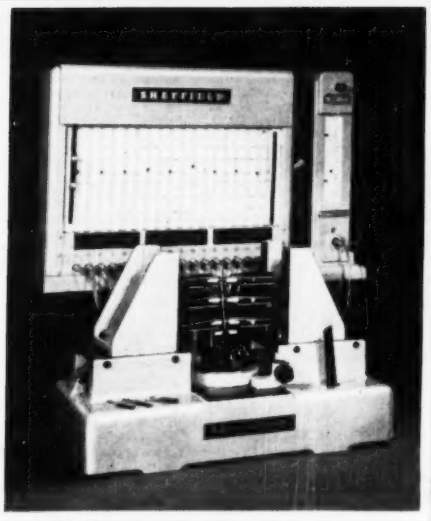
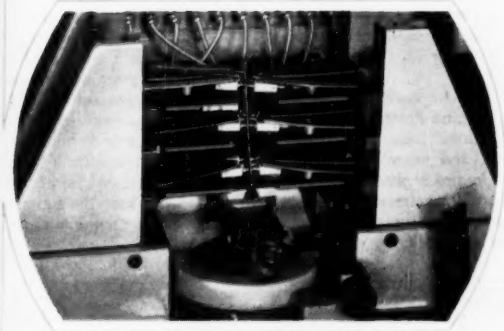
WIDELY USED For Inspection and Machine Control



The Plunjet is made with both rectangular and cylindrical short and long housings.



Plunjets with Precisionaire for checking jet engine blades.



Jet blade fixture using Plunjets.

PLUNJET GAGING CARTRIDGES . . . the self-contained gaging heads you can use practically everywhere, were developed by Sheffield in 1949.

THOUSANDS ARE NOW IN USE on a wide variety of gaging fixtures and machine control applications.

MORE THAN FIVE THOUSAND are used on gages for checking jet engine blades.

PLUNJET GAGING CARTRIDGES ARE STANDARD LOW-COST STOCK ITEMS which can be applied by users to practically any gaging fixture or machine tool control where indication is required.

***WRITE FOR ENGINEERING DATA** giving ranges, amplifications, applications, mounting dimensions and prices.*

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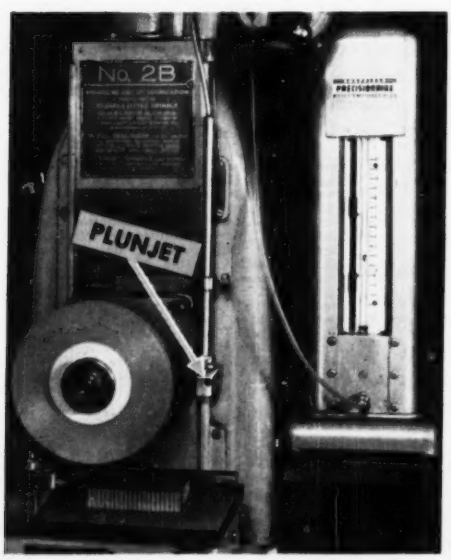

Plunjet feed gage enables operator to grind to a degree of accuracy previously impossible.

6302

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Achievement organization in Dearborn. Survived by two daughters, Barbara, Bloomfield Hills, Mich., and Louise, Santa Monica, Calif.

Horace Nelson Packard (1881–1953)

HORACE N. PACKARD, vice-president, treasurer, Cambridge Instrument Co., Inc., Ossining, N. Y., died Sept. 3, 1953. Born, Brockton, Mass., Dec. 11, 1881. Parents, Charles N. and Abbie (Ames) Packard. Education, ME, Ohio State University, 1908. Married Bertha M. Tilton, 1910. Jun. ASME, 1911; Mem. ASME, 1919. He was a member of Sigma Xi. Survived by wife; seven children, George N. Packard, Margaret J. (Mrs. J. C.) Warren, Elizabeth F. (Mrs. J. S.) Montaldo, David S. Packard, Richard A. Packard, Philip T. Packard, Jun. ASME, Robert T. Packard; 11 grandchildren; and a sister, Miss Sarah A. Packard.

William Ebenezer Reed (1866–1953)

WILLIAM E. REED, retired mechanical engineer of New York, N. Y., died Sept. 8, 1953, at his summer home at Blue Point, L. I., N. Y. Born, Elbridge, N. Y., Jan. 17, 1866. Parents, Rev. Albert C. and Sarah (Merriman) Reed. Education, graduate, Williston Seminary; ME, Cornell University, 1889. Married Emma Dupuy, 1902. Mem. ASME, 1898. Survived by wife, a son, Charles M. D., Rowayton, Conn.; two daughters, Mrs. L. H. Rhinelander, Charlottesville, Va.; Mrs. V. L. Bobbitt, Albion, Mich.; two brothers, Albert M., Manchester, Vt.; Rev. Harry L., Salisbury, Conn.; and 11 grandchildren.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print **Check mailing address**

Name.....
Last First Middle

Home address..... ☐
Street City Zone State

Name of employer.....

Address of employer..... ☐
Street City Zone State

Product or service of company.....

Title of position held.....

Nature of work done.....

Please register me in three Professional Divisions as checked:

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ V—Gas Turbine Power
☐ D—Materials Handling	☐ M—Production Engineering	☐ W—Wood Industries
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ Y—Rubber & Plastics
☐ F—Fuels	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ R—Railroad	

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Transactions.. ☐ Journal of Applied Mechanics.. ☐ Applied Mechanics Reviews.. ☐

Carleton Reynell (1886–1953)

CARLETON REYNELL, general manager, purchases and traffic, Worthington Corp., Harrison, N. J., died Sept. 7, 1953. Born, Elizabeth, N. J., March 16, 1886. Parents, William and Eva Reynell. Education, graduate, Riverview Military Academy; CE, Cornell University, 1907. Married Minnie Schoonmaker, 1911. He was the author of many articles relating to purchasing as a function of engineering. Assoc. Mem. ASME, 1920; Mem. ASME, 1923.

Richard Harnett Selfridge (1924–1952)

RICHARD H. SELFRIDGE, aeronautical research intern, National Advisory Committee for Aeronautics, Moffett Field, Calif., died Nov. 27, 1952, according to a notice received recently by the Society. Born, Long Beach, Calif., April 30, 1924. Education, graduate, Ketchikan (Alaska) High School, 1941; BS(ME), Washington State College, 1950. Jun. ASME, 1950.

John William Sheperdson (1879–1953)

JOHN W. SHEPERDSON, who retired in 1952 as executiv vice-president, Morgan Construction Co., Worcester, Mass., died Sept. 30, 1953. Born, St. Petersburg, Russia, of English parents, Aug. 21, 1879. Parents, William T. and Margret Sheperdson. Education, graduate, St. Katherine School, St. Petersburg; 2 years, Mechanical Institute of St. Petersburg; completed undergraduate studies in the evening school at Yorkshire College, a department of Leeds University. Naturalized U. S. citizen, Fitchburg, Mass., June, 1920. Married Mary H. Smith, 1904; children, Robert W. and John P. Assoc. ASME, 1908; Mem. ASME, 1911; Fellow ASME, 1952. He held either individually or in collaboration with coinventors 35 U. S. Patents relating to various equipment and developments in the engineering of continuous hot-rolling mills for the production of wire rods, merchant bars, billets, skelp and narrow strip, and the like.

Alphonso Taurman (1881–1953?)

ALPHONSO TAURMAN, whose death was reported recently to the Society, was superintendent, equipment and structure, Birmingham (Ala.) Electric Co. Born, Richmond, Va., Aug. 14, 1881. Education, Virginia Mechanics Institute; ICS. He held several U. S. Patents pertaining to locomotive equipment. Mem. ASME, 1949.

Albert Ball Tenney (1873–1948)

ALBERT B. TENNEY, public-utilities executive, 1900–1933, died Dec. 5, 1948, according to a notice received recently by the Society. Born, Everett, Mass., Jan. 8, 1873. Parents, Henry A. and Mary Elizabeth Tenney. Education, BS(ME), Massachusetts Institute of Technology, 1894. Married Mary A. Comey, 1902; children, Mrs. H. L. Ford, Richard H. Tenney. Jun. ASME, 1896; Mem. ASME, 1904.

William Tieke (1897–1953)

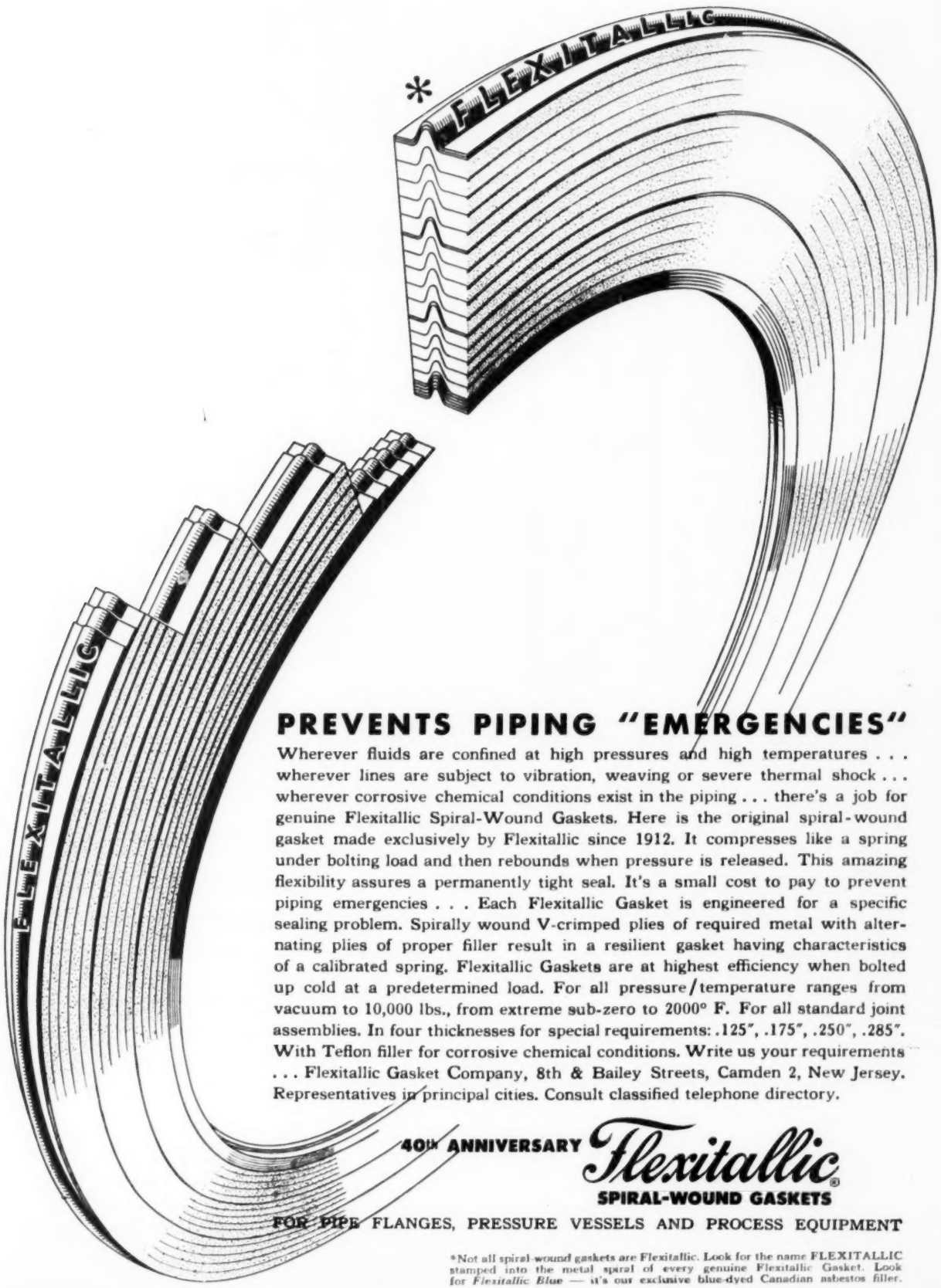
WILLIAM TIEKE, chief engineer, Aluminum Seal Co., Inc., Richmond, Ind., died in August of 1953. Born, Bremen, Germany, June 12, 1897. Parents, Johann and Meta Tieke. Education, ME, Technical University of Hanover, 1923; courses in industrial engineering, New York University. Naturalized U. S. citizen, Brooklyn, N. Y., June 2, 1931. Married Gertrude Porsche. Jun. ASME, 1927; Assoc. Mem. ASME 1932; Mem. ASME, 1935.

Sherman Melville Woodward (1871–1953)

SHERMAN M. WOODWARD, retired chief water-control engineer, Tennessee Valley Authority, died Sept. 7, 1953, at his home in Knoxville, Tenn. Born, Richfield, Minn., May 11, 1871. Parents, Emerson J. and Amelia (Scaife) Woodward. Education, MS, Washington University, 1893; MA, Harvard University, 1898. Married Gertrude B. Hughes, 1897; daughter, Miriam. Married 2nd, Christine M. Bachmiller, 1916; children, Amelia J., Mary E., Sarah M. Mem. ASME, 1907. At various times he served as consultant to the Miami Conservancy District, Dayton, Ohio; Chicago (Ill.) Sanitary District; and Tennessee Valley Authority. He was an honorary member of ASCE. Author of various Government Bulletins relating to hydraulics, flood control, irrigation, and drainage; coauthor, "The Hydraulics of Steady Flow in Open Channels," 1941.

Frank Beam Yingling (1873–1953)

FRANK B. YINGLING, president, Midwest Locomotive Works, Hamilton, Ohio, died Feb. 11, 1953. Born, Seven Mile, Ohio, Aug. 19, 1873. Parents, John H. and Catharine (Beam) Yingling. Education, two-year special scientific course, Miami University, 1893–1895. Married Elizabeth Goldsmith, 1900. Mem. ASME, 1917. He held several U. S. Patents relating to gun-carriage mechanisms, coating machines, measuring machines, and the like.



PREVENTS PIPING "EMERGENCIES"

Wherever fluids are confined at high pressures and high temperatures . . . wherever lines are subject to vibration, weaving or severe thermal shock . . . wherever corrosive chemical conditions exist in the piping . . . there's a job for genuine Flexitallic Spiral-Wound Gaskets. Here is the original spiral-wound gasket made exclusively by Flexitallic since 1912. It compresses like a spring under bolting load and then rebounds when pressure is released. This amazing flexibility assures a permanently tight seal. It's a small cost to pay to prevent piping emergencies . . . Each Flexitallic Gasket is engineered for a specific sealing problem. Spirally wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

40TH ANNIVERSARY *Flexitallic*®

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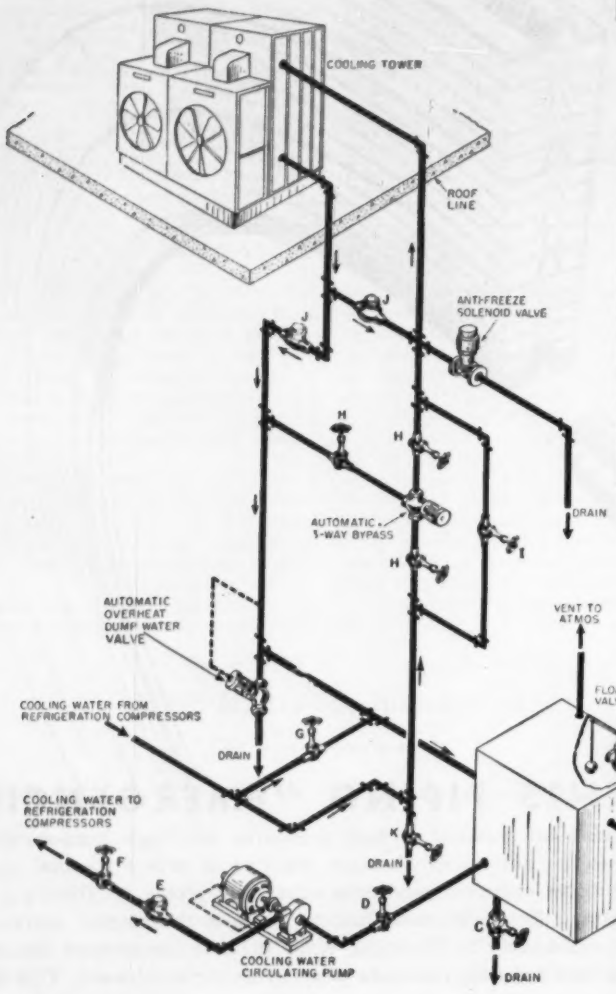
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

JENKINS PRACTICAL PIPING LAYOUTS

71



VALVE RECOMMENDATIONS
For details of valves to suit varying conditions, see Jenkins Catalog.

Code	Quan.	JENKINS VALVE	SERVICE
A	2	Fig. 106-A Bronze Globe	City Water Control
B	1	Fig. 92 Bronze Swing Check	Prevent Backflow into City Water
C	1	Fig. 106-A Bronze Globe	Drain for Storage Tank
D	1	Fig. 1243 T.S. Brz. Solder Gate	Shutoff Cooling Water Circulating Pump
E	1	Fig. 1222 Swing Check Sldr.	Prevent Backflow to Pump
F	1	Fig. 1200 Bronze Solder Globe	Pump Discharge Control
G	1	Fig. 1200 Bronze Solder Globe	Cooling Tower Manual ByPass
H	3	Fig. 1243 T.S. Brz. Solder Gate	Auto. 3 Way ByPass Shutoff
I	1	Fig. 1200 Bronze Solder Globe	Manual ByPass for Auto. Valve
J	2	Fig. 1222 Swing Check Solder	Prevent Backflow to Tower
K	1	Fig. 1200 Bronze Solder Globe	Cooling Tower Drain

Diagram by Huxley Madeheim, Consulting Engineer
COPYRIGHT, 1953 — JENKINS BROS.

How to plan PIPING CONNECTIONS *for a* NON-FREEZE COOLING TOWER

Where uninterrupted refrigeration is a round-the-clock operating requirement, a non-freeze cooling tower of the type illustrated here offers a dependable supply of cooling water at low cost. It also conforms with the water conservation regulations now enforced in many localities.

Since cooling tower and compressors must operate on the same schedule in any continuous refrigeration system—even when temperatures are below freezing—the water used in this system is stored in a vented or open tank located in a heated space, rather than in the conventional pan under the exposed tower.

When freezing weather occurs, an anti-freeze solenoid valve, actuated by a temperature-sensitive device, opens to drain all water from lines exposed to outside temperatures. The automatic 3-way solenoid valve permits the water to bypass the cooling tower under freezing conditions, or when it becomes too warm due to fan failure or overload in the storage tank. Under the latter conditions, the automatic overheat dump valve would also open. The subsequent drop of the water level in the storage tank causes the float valve to open and admit city water to make up the deficiency. Thus, in an emergency, city water would be used for cooling.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To simplify planning, to save time, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 71.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
SINCE 1864 TRADE JENKINS VALVE
Jenkins Bros

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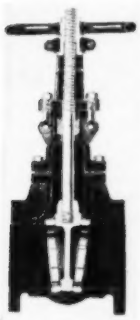
NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING.

NEW EQUIPMENT

Gate Valve for Mildly Corrosive Service

A new 125-lb iron gate valve, designed for mildly corrosive service in the process industries, has been announced by The Lunkenheimer Co. of Cincinnati, Ohio.



The cast iron body and bonnet of the new valve contain 3 per cent nickel, giving them an extra margin of corrosion-resistance over ordinary cast iron in many services. The trim is made of either 18-8 Mo stainless steel or all-monel.

The valve is priced lower than either all-stainless or all-monel valves, the company states, and lower than Lunkenheimer Causul Metal Valves which handle more severe corrosive conditions. It is designed to give economical service on mildly corrosive installations in the oil industry, pulp and paper industry, wood treating industry, and many chemical processing industries.

More information on the new 3 per cent nickel iron gate valve, as well as the complete Lunkenheimer Iron Valve Line, may be obtained by writing to The Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

Hand-Operated Spring Winder

The O'Neil-Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn., manufacturers of Di-Acro Precision Metalworking Machines, has announced the addition of a spring winding machine that can be operated without any experience or special skill.

The Di-Acro Spring Winder, according to the company, is a complete self-contained unit with a special cut-off lever incorporated right into the machine.

The company says the Di-Acro Spring Winder is ready for operation as soon as it's mounted on a bench or in a vise; that any gage wire, to $^1/_8$-in. diameter, can be wound into extension, compression, torsion, and flat springs; and that round, flat, square, or rectangular stock can be formed into springs of any length.

Cost of the Di-Acro hand operated spring winder is $85.00, complete with six arbors, with delivery approximately four weeks. Complete information will be furnished on request.

Pressure-Pipe Coupling

Ring-Tite is the name of a new coupling which Johns-Manville has developed for use with Transite pressure pipe. It can cut down expected installation time radically because the Ring-Tite coupling automatically centers, aligns, and provides for expansion, the company states. Up to now the Simplex Coupling has been the standard recommendation for underground pressure lines of asbestos-cement pipe. It consists of a sleeve and two rubber rings. The new Ring-Tite coupling

is made up of the same elements but the sleeve of Transite and the ends of the Transite pipe are of a different design.

The sleeve has two grooves cut circumferentially into the inner wall. These grooves locate the rings and hold them in position. To go with this sleeve, the ends of the pipe are machined to provide an entering taper back of which is a two-step machined area. The taper makes it easier to insert the pipe. The shoulder between the two steps provides a stop which halts movement as the pipe, rubber rings, and Transite sleeve slide together. When the rubber rings contact the stop shoulder the assembly is completed.

Further information is available from Johns-Manville, 22 East 40th St., New York 16, N. Y.

Drawing-Ink Fountain Pen

The Higgins Ink Co. has introduced a safety-type pen derived from the pen which was at one time manufactured by the Moore Pen Co. of Boston. For use with writing inks, safety pens of this type, in which the nib and feed retract into the barrel, were long ago replaced by sac-type self-fillers, but for use with waterproof drawing inks Higgins says the safety-type pen cannot be excelled. The reason for this is that the nib must be kept moist in order to prevent the waterproofing solution from drying on it. The retractable nib is therefore kept immersed in the ink when not in use.

The pen also uses interchangeable feeds. Thus the Higgins pen comes equipped with a gold nib already assembled on a feed which is in the pen when the purchaser buys it but which may be unscrewed and removed. In the box with the pen there are three extra feeds designed for use with many of the standard steel pen nibs preferred by artists, including those for manuscript lettering and also such types as Gillott's 290, 291, and 170.

Among the standard gold nibs offered Higgins lists Fine Line, Fine Flexible Sketching, Medium Flexible Sketching, Music Writing, Manuscript Stub, and Medium Manifold.

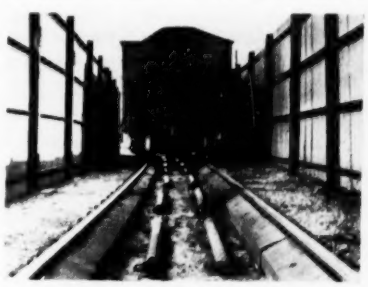
The company states that although designed for use with drawing inks, the pen is a standard safety-type pen and may be used with any ink, including Higgins' carbon signature inks, "Eternal" and "Engrossing." The pen is priced to retail at $10.00.

Car-Thawing Heaters

Norfolk & Western Railway Co. is utilizing short lengths of wrought iron pipe in a new car-thawing application designed to thaw coal frozen in open hoppers in cold weather, according to the A. M. Byers Co., Pittsburgh, Pa.

The "pilot model" of the device, a development of the railway's engineering department, is installed at the company's coal loading pier at Lamberts Point, Va. It performed satisfactorily in speeding up unloading operations when tested for a brief two-week period last winter.

In the car-thawing application, 24 lengths of 4-in. pipe are cut into small pieces and installed near ground level between the rails. Prior to installation, the top half of each pipe



is drilled with holes and a gas-fired jet inserted in one end. The compact heating units are then located in double rows at the center of the road bed. When the device is operating, heat from the jet is projected upward through the perforated area and helps melt the ice formations that otherwise keeps coal frozen in the hopper and prevents prompt and efficient unloading operations.

Norfolk & Western Railway Co. engineers selected wrought iron for the car-thawing application because of the materials's proven performance in resisting corrosion and because of its ability to withstand heat at intense temperatures, Byers declares.

Who could blame a person for having murder in his heart. After laboring over a drawing for hours, suddenly there's an unexpected blob of ink, and in a flash the drawing is ruined.

That's why it pays to specify Arkwright Tracing Cloth. Careful manufacture assures a working surface free of heavy threads, pinholes, and other imperfections that can lead your pen to disaster.

Arkwright Tracing Cloth is fortified, too, to take all the erasing you'll normally ever give it. Erase . . . and ink again. Lines will still come out sharp and clear — without "feathering". That's why Arkwright Tracing Cloth is ideal for good, readable blueprints.

Want to be convinced? Write for a free sample. Arkwright Tracing Cloth will convince you, just as it has thousands of others, it's truly "America's Standard". Arkwright Finishing Co., Industrial Trust Bldg., Providence, R. I.

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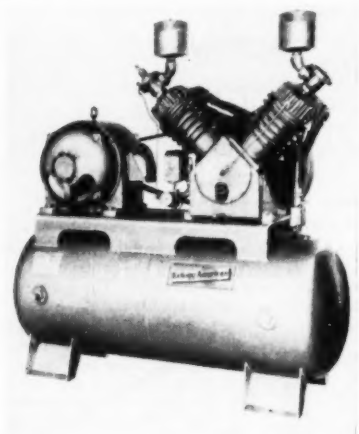
Air Compressors

The Kellogg Div., American Brake Shoe Co., 97 Humboldt St., Rochester, N. Y. has announced the addition of 15-hp and 20-hp air compressors to their present line. These new models extend the range of Kellogg-American air compressors from 1/3 hp through 20 hp with displacements up to 105.9 cfm.



Of V-type construction, these new Kellogg-American four-cylinder, two-stage air compressors are available in twenty-two different models. Model BD461A, the tank-mounted unit illustrated, features dual controls which permit either automatic stop-start operation for intermittent use or automatic intake unloader operation for use where air demand is constant.

Additional information in Catalog Sheet C-461 will be furnished on request.

Surface-Measuring Instrument

A new instrument for measuring surface roughness has been announced by the Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

The instrument, manufactured by Brush under an exclusive license from the General Motors Corp., is designed to measure the roughness of any surface. It provides a non-destructive test, is claimed to be versatile, inexpensive, and able to be operated without special knowledge or training.

The surface roughness range measured extends from 1 to 1000 μ in. average deviation from the mean surface. A variable cut-off switch permits the separation of waviness and roughness characteristics of surfaces by filtering out wave lengths exceeding 0.003, 0.010, or 0.030 in.

Accuracy is assured because the Surfindicator is equipped with Precision Reference Specimens which provide calibration of the instrument. These surface roughness specimens comply with the American Standards Association Standard B46.2, and the Society of Automotive Engineers' requirements.

The Surfindicator weighs 15 lb, and occupies less than 1/2 cu ft of space. It can be set up in any location where 115-v, 60-cycle current is available. Additional information on the Surfindicator may be obtained from the Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Speeders for Gear Inspection

The Michigan Tool Co. has added two models to its line of gear speeders. Both Models 1126 and 1126-A Speeders are designed principally for production-testing automatic-transmission gears. Model 1126-A Speeder is equipped with individual drive and brake for each spindle to allow for the testing of a set of gears at the same time. Model 1126 Speeder has only one spindle, driven while brake loads are applied to the second spindle. A reversible single-speed motor allows the spindle to be driven in either direction.

Sets of gears are tested on the new Model 1126-A Speeders by mounting the sun gear on one spindle and planetary gears on the other, alternately driving each spindle and applying a brake load to its mate. Gears are rotated in the same direction no matter which spindle is being driven. When the gears are meshed, the lock is positive; the gears are released manually when the cycle is completed.

A sun gear is tested on the left hand spindle of Model 1126-A at the same time that a planetary gear assembly is being tested on the right hand spindle. Double-action clutches are provided to change the drive of the spindles, which operate on coaxial shafts. These clutches always allow the opposite shaft to drive. Reversal of the motor simultaneously with the clutch reversal allows the gear sets to revolve in the same direction, whether they are driven or braked.

1126-A Speeder is V-belt driven by a 5-hp four-speed electrically controlled motor, allowing for speeds of 1800, 1200, 900, and 600 rpm on each spindle. Model 1126 is driven by a single-speed reversible motor. The external-contact friction brakes are manually operated and will accommodate a variable load.

Light-Duty Pillow Blocks

Recently designed and put into production, a new series of light-duty, low-cost, ball-bearing pillow blocks is available from The Fafnir Bearing Co., New Britain, Conn.

Designated as Type PB, these pillow blocks are described as a complete, ready-to-mount, economy package, which includes a separable two-piece pressed-steel housing, a

Fafnir Wide Inner Ring Ball Bearing with the Fafnir-originated Locking Collar, and patented Plya-Seals. The housing is designed to provide initial self-alignment in all directions and to assure ample strength for the light-duty applications for which it is recommended. Incorporated in this housing is a prelubricated Fafnir Wide Inner Ring Ball Bearing with Self-Locking Collar. Descriptive literature is available upon request from the manufacturer.

This book tells why Forgings are used for the toughest work loads

Engineering, production and economic advantages obtainable with closed die forgings are presented in this Reference Book on Forgings. Write for a copy.

There is no substitute for the strength and toughness inherent in closed die forgings. A product fortified with the metal quality found in forgings outperforms other products. Check all the aspects of a problem part with the unrivaled economic and mechanical advantages of closed die forgings and the closed die forging process for producing parts. Double-check all parts, particularly those which are subjected to great stress and strain. Then consult a Forging Engineer about the correct combination of mechanical properties which closed die forgings can provide for your product.

DROP FORGING ASSOCIATION
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Please send 64-page booklet entitled "Metal Quality—How Hot Working Improves Properties of Metal", 1953 Edition.

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-*hp*- 522B ELECTRONIC COUNTER

This new electronic counter can save you time and money by speeding and simplifying research and manufacturing measurements. It is a compact, low-cost, extremely versatile instrument offering you accurate frequency, period *or* time measurements. It performs all functions without extra-cost modification. Results are displayed instantly and automatically in direct-reading form. Unskilled personnel can use the instrument immediately without training.

Model 522B measures rate of occurrences from .00001 to 100,000 per second. It measures time from 10 microseconds to 27.8 hours. Counting is available over periods of 1/1000, 1/100, 1/10, 1 and 10 seconds or multiples. Stability of time base is 5 parts per million. Time of display can be varied to any duration, counts are automatically reset, action is repetitive. Results are presented direct in cps, kc, seconds or milliseconds. Decimal point is automatically indicated. Maximum dependability is assured by careful design and construction, and use of quality components. Price: $900.00 f.o.b. factory.

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Data subject to change without notice.

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INSTRUMENTS FOR COMPLETE COVERAGE

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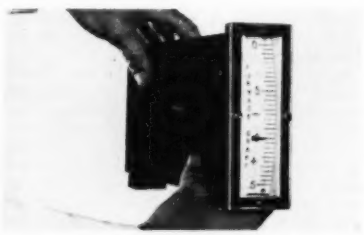
Draft and Differential-Draft Gage

A bantam gage for measuring draft, pressure, vacuum, or differential draft has just been announced by Republic Flow Meters Co., of Chicago. Republic design engineers state this is the first small-size draft and differential-draft gage complete in one case. No extra transmitters or accessory mechanisms are needed for its operation, they explain.



The 5-in. graduation length of the V-5 scale compares favorably with the scale length of larger sized gages. Illumination from the rear by either incandescent or fluorescent bulbs increases visibility and readability at distances. The gage can be connected into standard lighting circuits.

Full-sized diaphragms or bellows are used in the gage. Diaphragm elements are available for pressure ranges as low as 0.6 in. and as high as 40 in. of water. Equipped with bellows elements, the gage may be used as a receiver for pneumatic transmission pressures between 5 and 30 psi. The gage can also be furnished with two bellows and two pointers for steam flow-air flow or fuel-air indication.

Specification Folio No. 805 gives details about the gage. It's free from Republic Flow Meters Co., 2241 Diversey Pkwy., Chicago 47, Ill.

Time Delay Relay

For control circuits requiring a time delay initiated by a momentary impulse, such as from a pushbutton or microswitch, a new Agastat time delay relay has been developed by the AGA Div., Elastic Stop Nut Corp. of America, Elizabeth, N. J.

Like other Agastats, the new NEH Agastat is a lightweight, compact relay with pneumatically controlled time delay adjustable over a range from 0.1 sec to 10 min, or more.

Time delay is controlled by the flow of air through an orifice. Air used for timing is recirculated within the timing chamber. Size of the orifice, which determines the length of time delay, is determined by a needle valve adjusted by a screw on top of the timing chamber.

The NEH Agastat has a normally-closed auxiliary hold-in switch. In the deenergized state, the auxiliary switch contacts are held open by the operating spindle, which is an extension of the solenoid core. On energization of the Agastat coil, these contacts close to keep the coil energized. The Agastat switch operates at the end of the time delay.

Including the auxiliary switch, the largest NEH Agastat is $5^7/_8$ in. high and $2^1/_2$ in. square. It is available for all standard a-c and d-c voltages, in single-pole, double-throw, or double-pole, double-throw models. The Agastat switch is rated 15 amp at 115 v, 60-cycle alternating current.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Impregnators for Sealing Micro-Porosity in Castings

L. O. Koven & Brother, Inc., Jersey City, N. J., has completed fabrication of special impregnators for sealing micro-porosity in cast electronic and aircraft parts with styrene base material, varnish, or wax. A battery of four of the new 36-in. diameter impregnators is shown.

The process works as follows: Castings are loaded into baskets which, in turn, are lowered into the vacuum chamber of the impregnator. The chamber is evacuated, the castings being thoroughly de-aerated prior to impregnating. Impregnating solution is

next pumped into the tank. Pressure of 100 psi is then applied and maintained long enough to assure full, deep penetration of the castings by the solution. Tank and jacket are designed for this 100-psi pressure. After impregnation is completed, excess solution is flushed out through piping in the bottom of the tank.

The impregnator is fabricated of $^3/_8$-in. carbon steel with a $^1/_4$-in. cover. This cover is gasketed, equipped with swingbolts and pivot-mounted with counterweights (not shown in photograph). Counterweights consist of 16 1-in. iron plates on counterweight bar.

Inner-Cooled Generator

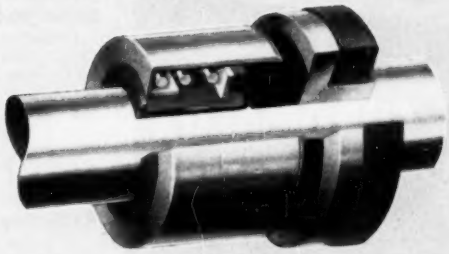
What is said to be the world's first completely inner-cooled generator, described by Westinghouse engineers as one that will open a new era in the history of power generation, has been shipped from the East Pittsburgh plant of the Westinghouse Electric Corp.

Purchased by Niagara Mohawk Power Corp. for installation at Buffalo, N. Y., the new unit is rated at 100,000 kw and is powerful enough to light a city the size of Nashville, Tenn. However, it is only slightly larger in physical size than the average 40,000-kw machine. The new generator weighs about 350,000 lb which is about 150,000 lb less than the average 100,000-kw unit.

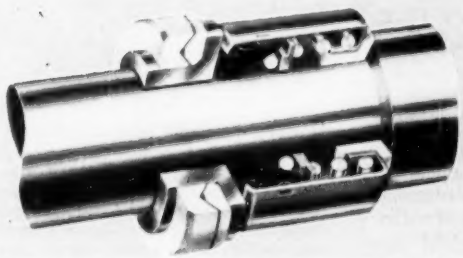
The key to the increase in power rating, while the physical size is reduced, lies in a new Westinghouse-developed cooling system for large turbine generators. This system is designed in such a way that the cooling agent, hydrogen gas, comes in intimate contact with only not the bare copper of the coils in the rotating part of the generator, but also with the copper coils of the stationary part of the machine. After carrying the heat away for disposal, the hydrogen is then recirculated through the machine. Up to this time the hydrogen had been able to pick up only the limited amount of heat that seeped through the insulating jacket covering the copper and steel.

Garlock "Package" Seals
FOR ROTATING PUMP SHAFTS

Type BB-21A—Garlock Package Seal of standard construction with brass shell, brass washer, and Buna-N bellows.



	TYPE BB-21A	TYPE AA-21A
Liquids	For water, oils, alcohol, solvents (except aromatic, chlorinated and ketone types) and other liquids (except strong acids).	For very strong acids, oils, solvents (including aromatic, chlorinated and ketone types) and all other liquids.
Equipment	Rotating shafts of centrifugal pumps, process pumps, chemical pumps, agitators and similar applications.	
Sizes	For shafts from ⅜" to 3" diameters.	
Temperatures	With Buna-N bellows up to 212°; with silicone bellows up to 450° F.	Up to 450° F.
Pressures	Up to 150 p.s.i.	Up to 150 p.s.i.



Type AA-21A—Garlock Package Seal with hat-shaped "Teflon" drive ring, brass or 316 stainless steel shell and washer, "Teflon" 'O' ring, and "Teflon" two-piece vibration ring.

✓ CHECK THESE IMPORTANT FEATURES

- ☐ Occupy very small space
- ☐ Completely assembled—ready to install
- ☐ Proven performance at low cost
- ☐ Both types are dimensionally interchangeable

In both of these Package Seals, a leakless seal is provided by a positive contact between carefully lapped metal-to-carbon mating surfaces. All metal parts in both types are available in plated-brass, Ni-Resist, stainless steel with malcomized face, Garlock "B" iron, and others.

For complete details, ask your Garlock representative or write us about your sealing problems.

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LOWER HEATING COSTS

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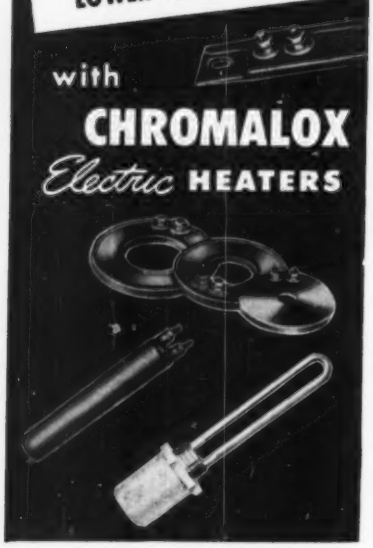
Electric HEATERS



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Want the quick, low cost answer to almost any heating problem in your plant? Get it with Chromalox Electric Heaters! Over 15,000 types and sizes for heating dies, molds, platens; for preheating oil and superheating steam; for heating asphalt, greases, oils; for drying, curing, baking, dehydrating and other heating jobs. See how Chromalox Electric Heat can help cut your costs!

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Small 50-hp Boiler

Cyclotherm Div., United States Radiator Corp., Oswego, N. Y., has announced a 50-hp fire-tube steam boiler, said to be the smallest manufactured. The new power package, called C1725 by Cyclotherm, takes up an area of 20 sq ft, is 4 ft 8 1/4 in. high. A simple flue vent is all that is necessary to operate at about 80 per cent efficiency, the company states.

Recording Oscillograph

As many as six active data channels in the 0-300 cycles-per-sec range are recorded simultaneously with positive time correlation by the Type 5-117, Consolidated Engineering's latest, low-cost recording oscillograph. The instrument provides an accurate record of any static or dynamic phenomenon convertible to an electric signal through use of the proper pickups. Measurements possible include strain, pressure, vibration, torque, acceleration, and position.

The 5-117 makes it possible to conduct many tests without the use of amplifiers, for the galvanometers employed are highly sensitive and may be driven directly by very small electrical signals. Easily changed gears provide six discrete record speeds from 3/4 to 24 in. per sec. Data is photographically recorded, and trace deflection is hence limited only by the record width.

Power required is 115 v, 60 cycle alternating current. Details are contained in Bulletin CEC 1533, available on request from Consolidated Engineering Corp., Pasadena 15, Cal.

General-Purpose Metal Detector

A general-purpose metal detector which can be installed around conveyor systems without cutting the belt and can be adapted to special applications has been announced by the General Electric Co.'s Special Products Section.

Developed by the company's General Engineering Laboratory, the new device can be used in manufacturing processes involving the inspection of non-magnetic and non-conductive materials. Belt speeds can range from 90 to 500 ft per min.

In industrial food operations the GE detector will discover metal particles in such products as cereals, candy bars, and many packaged food products. It is also adaptable for application in the paper and lumber industries for small logs. The detecting component can be immersed in the log pond and logs floated through for a metal inspection. Larger units can be made for larger logs.

In the mining field special design features allow the equipment to be installed under adverse conditions to detect metals in non-magnetic and non-conductive types of ore.

Stearns Magnetic, Inc., of Milwaukee, Wis., also will sell the new GE detector as a distributor and specialize in complete automatic installations.

In operation, the device detects metal by perceiving the effect of the metal particles on the characteristics of an inductance bridge circuit. The coils which make up the inspection unit are elements of this bridge circuit, and a metal particle coming into the inspection aperture causes the bridge to become unbalanced electrically. The output (or unbalance signal) of the bridge is then amplified and used to operate an appropriate alarm or control.

Power requirements are 105/125 v, 60 cycle, 150 w.

Streamlining SAVES PRECIOUS FUEL

STREAMLINE the flow of gases across the boiler tubes and you get more steam from less fuel. That is what Enco Baffles do. They use scientifically curved baffle surfaces instead of sharp angles. They taper the passes to maintain velocity as the gases decrease in volume, which promotes heat-transfer. They:

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Adaptable to any type of water-tube boiler, fired with any fuel. Designed for each individual installation. Only selected materials used. Installed by skilled mechanics. Send for Bulletin BW 44.

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NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Resin Finishes

Two new products have been announced by the Parker Rust Proof Co. The new products are Parcolac 101 Black and Parcolac 102 Aluminum, new pigmented phenolic resin finishes for use over Parco Compound.

Developments of the Parker Research laboratories, the new Parcolacs have undergone laboratory and field tests, and have been proven in production runs on iron and steel articles of many sizes, shapes, and uses.

Parcolac 101 Black produces a deep black color; Parcolac 102 Aluminum creates an even, light-gray finish which looks like a plating of aluminum. Both products claim excellent corrosion resistance. Production pieces, finished with these Parcolacs over Parco Compound, have withstood 100 hr in salt spray, the company states.

Sealed Miniature Bearings

Dirt, lint, and contaminated atmospheres will no longer be a limiting factor in the application of miniature ball bearings according to Miniature Precision Bearings, Inc., Keene, N. H. The company has announced a new series of single- and double-shielded miniature fractional-inch-size precision ball bearings of both full-race and retainer construction, not previously available. These new bearings, down to 0.1562 ($^5/_{32}$) in. outside diameter are now in production in nine sizes.

The single-shield design bearings are dimensionally interchangeable with the MPB standard unshielded types in most sizes. The double-shielded series bearings are of slightly increased width over catalog dimensions for standard miniature ball bearings.

Miniature Precision Bearings, Inc., manufactures ball bearings in overall diameters from $^1/_{16}$ to $^5/_{16}$ in. in more than 150 standard types and sizes. The new shielded bearings are being produced in both chrome bearing steel and stainless steel; all shields are of stainless steel. The bearings are used in a variety of precision mechanisms such as miniature blowers, small electric motors, and textile rollers.

Fork-Lift Truck for Highway Trailers

Clark Equipment Co., has announced the development of an attachment that enables a standard-heavy duty fork lift truck to position a highway trailer quickly on a railroad flatcar.

The attachment was designed for use with the standard 26,000-lb capacity Ross Fork-Lift Truck, a product of Clark Equipment Co. It was developed at the invitation of Electro-Motive Division of General Motors Corp. in conjunction with the Rail Highway Coordination Program sponsored by that firm.

The fork truck is modified to allow side-loading and unloading of highway trailers up to 35 ft in length onto a specially designed railway car which will transport two trailers. The modification consists of a special short upright and a standard side-shifter with toed-in forks that support a pin which fits into a recess at the front end of the trailer.

After the lift-truck has engaged the recess or "toe-plate" of the trailer, it maneuvers the trailer aboard the rail car and locks the trailer in place by dropping the trailer kingpin in a slot in the stanchion of the railway car.

The modified Ross Fork Truck is available for immediate delivery, the company reports.

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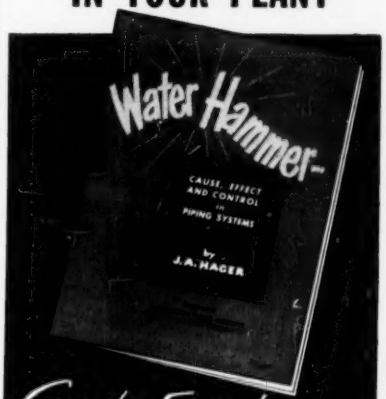

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Don't let dangerous water hammer wreck the piping system in your plant. Learn the cause, effect and control of this costly nuisance.

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"MULTIPRESS — Blanking & Forming"

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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Largest Titanium Die Forging

Said to be the largest titanium alloy die forging made today is this 100-in.-long propeller blade forged by Ladish Co., Cudahy, Wis. Designed by Hamilton Standard Div., United Aircraft Corp., and forged from Titanium Metals Corp.'s titanium high-strength alloy Ti-140-A, the blade is destined for use in a special research project for the US Air Force.

Utilizing the forging process in combination with such metals as titanium, design engineers have achieved significant results in reducing weight while imparting greater strength to a wide variety of components, Ladish declares.

Geared Flexible Couplings

Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill., has announced a line of geared flexible couplings for high-speed and high-torque applications. Besides transmitting power efficiently, they accommodate a reasonable amount of shaft misalignment and end float, Link-Belt states.

Ten standard sizes are available, with bores ranging from 1 in. to 6 in. and with horsepower rating at 100 rpm ranging from 2 to 450. Hubs bored for either slip or shrink fit on shaft can be furnished. The two-section, free-floating housing has internally cut gear teeth. The two sections are rabbet-fitted and are bolted together.

Link-Belt Folder No. 2375, giving detailed description, dimensional tables and selection data, will be sent on request.

Torque Wrench

To tighten nuts accurately to any predetermined stress during the construction or servicing of equipment in plant, laboratory, or field, Manzel Div. of Frontier Industries, Inc., 315 Babcock St., Buffalo, N. Y., is now offering a torque wrench with a capacity from 0 to 1000 ft-lb. The "Stay Set" dial registers torque reading and remains at maximum after tension is released. Thus a check of obtained tension is possible after pulling has ceased. The dial is reset by turning the center knob.

When the Manzel Torque Wrench is used, each bolt will carry its proportionate share of the designated load, the manufacturer states.

Welding Electrode With Powdered Metal

The Lincoln Electric Co., Cleveland, Ohio, has announced a new electrode called Jetweld, which incorporates powdered metal into the electrode coating. Jetweld is a heavily coated shielded-arc type of electrode for operation in flat or near-flat positions with a-c or d-c welding current. It meets the physical requirements of class E-7016 and is used on work formerly called for E-6012 and E-6020 electrodes on single-pass or multiple-pass welds. It is said to be especially well-suited for horizontal and flat position fillets, horizontal and flat position laps, single- and multiple-pass butts, deep grooves and corners, and cover pass on multiple-pass butts. It is recommended for welding some higher carbon steels. Weld metal is uniform x-ray quality, free from undercut with better impact values at low temperatures than is possible with electrodes other than low-hydrogen types. Typical physical properties, as welded, are: tensile strength, 93,000 psi; yield point, 79,000 psi; elongation in 2 in., 15 per cent to 22 per cent. Typical Charpy keyhole impact value at room temperature is 28 ft-lb. At −70 F value is 20 ft-lb.

Welding speeds claimed as typical in lap and fillet work are 12 to 15 in. per minute. Jetweld is available in $^5/_{32}$-in., $^3/_{16}$-in., and $^1/_4$-in. sizes.

Safer . . . Happier

thanks to Christmas Seals!

Like a protective radar network, a barrier formed by Christmas Seals helps to guard us against tuberculosis.

The money which *you* donate for Seals fights TB the year round — with continuing medical research, education, rehabilitation, and case finding.

To keep the barrier high, send your contribution today, please, to your tuberculosis association.

Buy Christmas Seals

Because of the importance of the above message, this space is contributed by **MECHANICAL ENGINEERING**

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Tower Packing

Where extreme corrosion conditions predominate, Kel-F Raschig rings and perforated Kel-F disks for packing support are said by the manufacturer to be the answer to refluxing, scrubbing, and contacting of process materials.

United States Gasket Co., Camden, N. J., offers perforated plates or disks in thicknesses up to 1 in. and over. Various sizes of holes

and perforation patterns are available to meet specific requirements. In addition, Raschig rings are supplied to complete the unit. A factor in the use of Kel-F Raschig rings is the fact that they can be reclaimed or recycled by the use of any inorganic material or acid, should the process require, the company states. Further information will be provided by United States Gasket Co., Camden, N. J.

Check Valve

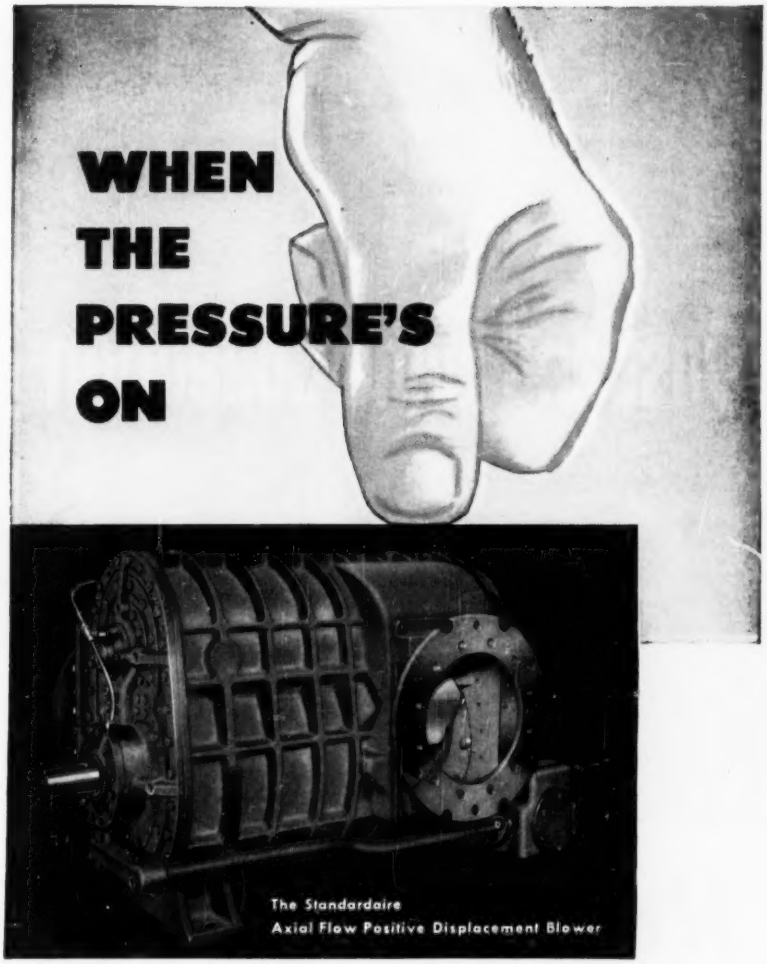
Spherical poppet-nose and matching seat in the new Republic "Free-flow" Check Valve always assure perfect leak-proof seal, Republic declares, because they are self-aligning. The caged poppet is claimed to give "lower-than-ever" pressure drop and practically no flow restriction in non-surge hydraulic systems to 3000 psi. While the standard opening pressure is 3 oz, stronger springs are available so these units can be used as combination in-line relief-check valves. The check valves are available in various combinations of tube and pipe ports, for operating temperatures −65 to 200 F, and higher on order, in most common metals, in sizes $^1/_8$ in. to 1 in. More information will be supplied by Republic Mfg. Co., 1930 West 77th St., Cleveland 2, Ohio, in Bulletin No. 1053.

Gas-Fired Unit Heaters

A new line of gas-fired unit heaters for automatic, direct-fired heating of industrial and commercial areas has been announced by Grinnell Co., Inc., 260 W. Exchange St., Pyovidence 1, R. I. The eight-model line of Grinnell gas-fired unit heaters is made in capacities from 20,000 to 160,000 btu per hr.

The heaters can be used with natural, manufactured, mixed, or liquefied-petroleum gases, and are equipped with motor-driven fans ranging from $^1/_{30}$ to $^1/_6$ hp, depending upon the capacity of the unit. The louvers on the Grinnell gas-fired unit heaters are individually adjustable. Safety against the danger of escaping gas is provided by an automatic safety pilot which shuts off the gas supply if the pilot burner goes out.

Grinnell gas-fired unit heaters are manufactured in compliance with the safety requirements of the American Gas Association and bear their approval seal.



for increased air handling efficiency . . .

Consider a Standardaire Axial Flow Positive Displacement Blower *first*. Its unusual design features provide the greatest output per pound of weight ever achieved in this type of blower.

The Standardaire Blower employs an exclusive means of compression which provides a wide range of pressures with a minimum of internal losses. It can be operated at high speeds, permitting direct drive by favorably priced, standard motors in an efficient speed range.

Air is drawn in and discharged smoothly. Compression is gradual and free from the shocks which load internal parts and decrease efficiency.

These are but a few of the unique features of this compact unit which assure outstanding results. For further information, write . . .

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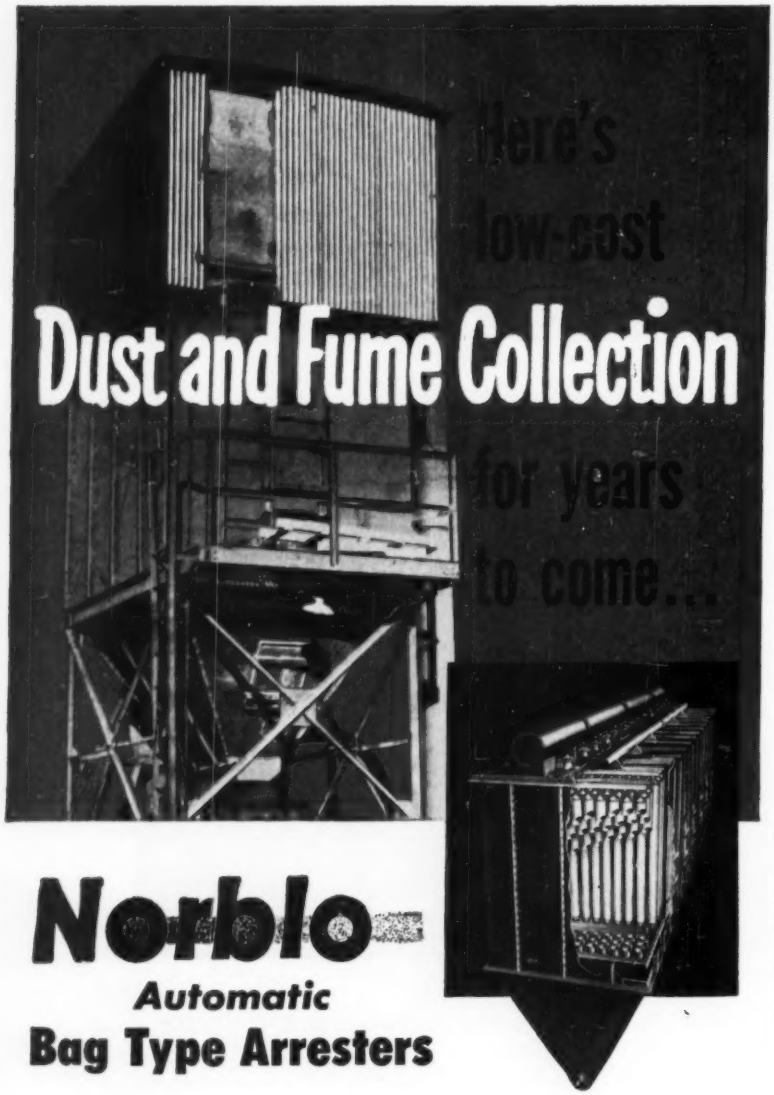

Norblo

Automatic

Bag Type Arresters

Norblo equipment is based on sound, experienced engineering and takes full account of the *scale* of your operation as well as *time* factors, so that Norblo performance can be *guaranteed.*

Norblo arrester design is based on multiples of a basic, standardized compartment. Bag cleaning—fully automatic—is cyclic and periodic, taking only a few seconds for each compartment. In continuous, heavy duty operation, full calculated capacity of Norblo equipment is always available, and investment for equipment of any desired capacity is held to a minimum.

Norblo gives you all four essentials of low cost operation for years to come—advanced design, high efficiency, long life and low maintenance. Write for Bulletin 164-4.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

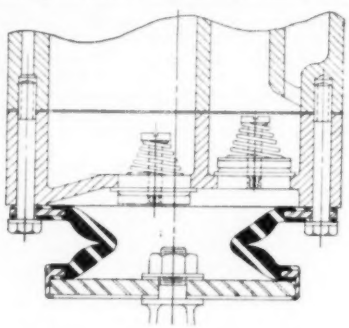
1250-Ton Aluminum Extrusion Press Installed

A new 1250-ton Watson-Stillman aluminum extrusion press has been installed at the Keystone Alloys Co., Derry, Pa. The press is of the four-column, hydraulically operated, long-stroke design, capable of handling billets up to 24 in. in length. It is powered by Oilgear radial-type piston pumps and incorporates the latest press design features.

With this press Keystone Alloys will extrude aluminum sections used in the manufacture of their Keystone aluminum storm-screen doors, storm windows, and casement storm windows.

Bonded-Rubber Pump Diaphragm

Originally designed by Lord Mfg. Co. for use in shallow-well pumps, the Lord Bonded-Rubber Diaphragm shown claims a record of over 3500 hr of continuous operation with no drop in pump efficiency. The efficiency of the pump including this type of diaphragm is higher than comparable-size piston or jet types, according to Lord. To improve the performance of diaphragm pumps, thus reducing shut-down time and replacement cost,



Lord Bonded-Rubber Diaphragms are manufactured from elastomers which resist the attack of corrosive solutions and abrasive slurries. The diaphragm also provides quieter pump operation. Other applications for this diaphragm exist on many hydraulic- or air-actuated units. The Lord Bonded-Rubber Pump Diaphragm can be made in a complete range of sizes.

Further information will be provided by Lord Mfg. Co., Erie, Pa.

Fraction-Conversion Calculator

A device for adding and subtracting fractions and decimal and metric equivalents of fractions, and millimeters and the inch equivalents of millimeters, has been introduced by William H. Doring, 6921 Sixth Ave., Brooklyn, N. Y. Fractions in sixty-fourths of an inch, or higher, can be added to or subtracted from other fractions or their decimal or metric equivalents, without conversion, and the result expressed in fractions, decimal fractions, or millimeters by reading the appropriate scale.

The reverse side of the device is used for the adding and subtracting of millimeters or their inch equivalents, the result being read either in millimeters or inch equivalents.

Called the Plus & Minus Mechanical Chart, the device consists of three embossed metal wheels and is $3^3/_4$ in. in diameter. Further information is available from William H. Doring.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Angle Head for Impact Tools

Ingersoll-Rand Co. has announced a new Angle Head Attachment for use with their electric Impactools. Two sizes are available, one for use with Impactools with 1/2-in.-square drivers, the other for use with Impactools with 3/8-in.-square drivers.

The Angle Head Attachment snaps on the Impactool like a socket, and can be rotated 360 deg in relation to the Impactool handle. The height (to the shoulder of the square driver) measures 3 in., and the overall length is 6 1/4-in. A die-cast aluminum housing keeps the weight of the unit at a minimum. Ball and needle bearings are used throughout, and the bevel gears are made of heat-treated, alloy steel.

Any sockets, chucks, etc. used on Impactools will work as well on the Angle Head Attachment. The unit is sold through Ingersoll-Rand distributors. Further information can be obtained from Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Polyphase A-C Motors

A new line of polyphase a-c motors, offering better protection, more efficiency, and quieter operation has been announced by the General Electric Co.'s Small Integral and Medium Induction Motor Depts.

Called Tri-Clad "55," the new motors are the result of more than 250,000 man-hours of developmental engineering and research, the company states.

With an average size reduction of 50 per cent by volume and averaging 22 per cent less weight per horsepower, the "55" retains rigid cast-iron construction and incorporates a new insulation system, bearing assembly, and ventilation plan, according to GE engineers.

After the first of the year, the new motors will be available in the 182 and 184 frame sizes (1, 1 1/2, and 2 hp at 1800 rpm) in horizontal drip-proof and totally-enclosed fan-cooled models, and in a complete line of gear-motors. Larger frame sizes will become available at regular intervals.

Other types planned for production during 1954 include vertical, single-phase, wound rotor, explosion-proof, multi-speed, face-mounted, and flange-mounted models.

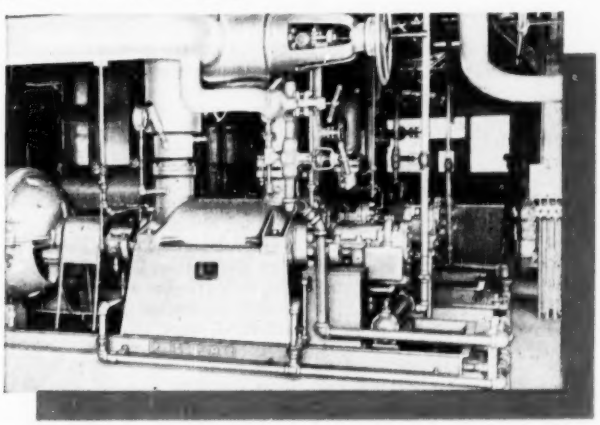
Pacific PUMPS

Eliminate Stop Signs...

Provide Constant Power Generation Traffic!

Electric power generation and transmission are geared to continuous, indefinite operation. A vital link in keeping this electrical energy on the GO is Pacific boiler feed pump installations – both operating and standby. For more than two decades, Pacific has built feed pumps for this exacting service in central stations and industrial power plants on four continents.

Sizes installed range from the midgets of less than 50,000 lbs. per hour to the giants having a capacity of 1,000,000 lbs. per hour. The operating discharge pressures range from 200 to 2500 psig. More than 50 units are operating at discharge pressures above 2000 psig.



To insure GO in your central station or industrial power plant, specify boiler feed pumps by Pacific Pumps, Inc. For more information, write for Bulletin 109.

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BF-18

ELECTRO | MECHANICAL

Engineers

For research and development of electromechanical radar and computing equipment.

Significant advancements in the fields of airborne radar and fire control systems are requiring further applications of electromechanical techniques in the Hughes Radar Laboratory.

The company

Hughes Research and Development Laboratories, located in Southern California, form one of the nation's leading electronics organizations. The Laboratories are presently engaged in the development of advanced electronic systems and devices which are produced by the Hughes manufacturing divisions.

Areas of work

The work calls for devising reliable, maintainable, manufacturable designs for precision equipment developed in the Hughes Radar Laboratory. The equipment consists of mechanical, electronic and microwave devices and systems to be manufactured in quantity. The equipment designs require the use of such advanced techniques as subminiaturization, unitized "plug-in" construction, with emphasis on design for volume production. Knowledge of electronic components, materials, finishes and specifications is useful.

The future

Engineers experienced in the field of electromechanical design for production or those interested in entering this field will find outlets for their abilities and imagination in these activity areas. New electromechanical techniques are opening new applications for airborne electronic equipment. Hughes engineers will have the full benefit of working experience in these fundamental developments.

Assurance is required that relocation of the applicant will not cause the disruption of an urgent military project.

Address resume to **Scientific and Engineering Staff**

Hughes

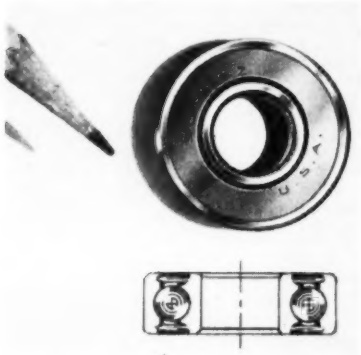
Research and Development Laboratories

Culver City, Los Angeles County, California

KEEP INFORMED — NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Commercial Bearing With Plastic Seal

Using a new molded plastic seal, The Schatz Mfg. Co., 6762 Fairview Ave., Poughkeepsie, N. Y., is making a low-cost commercial bearing, the CS 3258, which has been used in washing machines, business machines, farm equipment, power mowers, small electrical motors, tensioning devices,



and in many other applications where speeds and loads are moderate enough to allow using a commercial bearing. In each case the CS 3258 was used to replace a more costly precision bearing, and resulting savings ranged up to as much as 60 per cent, according to the manufacturer.

The bearing has carburized and hardened raceways, and all surfaces are ground. Bearing is available in either English or metric sizes, OD ranging from $^{5}/_{8}$ to 2.047 in. (52 mm), bore from $^{3}/_{16}$ in. to one inch, with or without either plastic seals or metallic shields, or both.

Projection Emulsions

Two new projection-speed emulsions coated on several base materials have been added to the range of sensitized photocopying materials offered by Peerless Photo Products, Inc., Shoreham, Long Island, N. Y. Both are available in all standard sizes of both cut sheets and rolls.

Both of the new emulsions are said to have an unusually high contrast for emulsions which are processed in conventional metol-hydroquinone developers. Such contrasts are normally available in emulsions whose characteristics can only be brought out by special high alkali developers which have very poor keeping qualities.

The first of the two new Peerless emulsions, designated Projection B, has high contrast and density. It is blue-sensitive, and is not color-sensitized. Projection B emulsion has the same speed as the former Peerless Projection Vellum, which it replaces, but the new emulsion is claimed greatly superior to the older product in both contrast and density. Its principal use is for making "blowups" from microfilm or glass template negatives. It is available coated on waterproof tracing cloth or on vellum. When developed in the recommended developer formula, Projection B emulsion develops in from 45 sec to 2 min with good latitude.

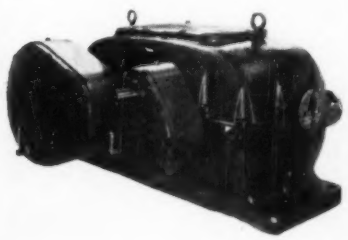
The second new Peerless emulsion, which has the same high contrast and density characteristics as Projection B, is designated as Neoflow. It is available coated on vellum,

on 005 document stock (100 gm), or on single weight 007 glossy stock. Originally developed for use in the Peerless Neoflow reducing camera, the new emulsion is a useful material for copying line work in any type of camera. Its speed is about twice that of the new Projection B emulsion. Neoflow is an orthochromatic emulsion, with sensitivity extending well into the orange band, which makes it suitable for copying blueprints and other colored originals. In the recommended formula, Neoflow develops in from 45 sec to 2 min.

Variable Speed Drives

Link-Belt P.I.V. (positive, infinitely variable speed) drives are now available in two new types for 20- to 25-hp applications, the company has announced.

In addition to the basic H-6 P.I.V. of 25-hp capacity, Link-Belt Co. can now supply an HG-6 drive, furnished with either a single-reduction input or single-reduction output helical-gear attachment, or an HGG-6 drive, furnished with both a single-reduction input and single-reduction output helical-gear attachment.



Input gear reductions are available from 1.93:1 minimum to 5.82:1 maximum, and output gear reductions from 1:1 to 6.33:1. Speed-increasing gear sets are also available.

The complete Link-Belt line includes P.I.V. drives in eight sizes, ranging from ½- to 25-hp. capacity, with ratios up to 6:1, in 16 types, for horizontal and vertical mounting, with and without helical gears and integrally mounted motor.

The P.I.V. variable-speed drive claims accurate speed control adjustable over a wide range of speeds. It transmits power positively, without slip, by means of a drive chain with self-forming metal teeth that engage with radial grooves in two pairs of cone-shaped wheels. Ratio is changed by altering the effective diameter of the wheels.

Link-Belt Folder No. 2374, recently released, provides detailed information on the size 6 P.I.V., in its three types and many ratios and assembles. A copy will be furnished by Link-Belt Co., 307 N. Michigan Ave., Chicago 1, Ill., on request.

Force-Measurement Load Cells

Two new series of "precision" and "extra-precision" type Baldwin SR-4 load cells for measuring forces and weights, based on the SR-4 bonded resistance wire strain gage, have been announced by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa. They include 18 compression load cells (Type CX and CXX) in nine capacities ranging from 500 to 200,000 lb and 16 tension load cells (Type TX and TXX) of eight capacities ranging from 500 to 100,000 lb.

These precision and extra-precision load

Tuesday, October 21, 1952 THE MIAMI HERALD 21-A

Financial News

Winn & Lovett's Earnings On Rise

By United Press

JACKSONVILLE—Winn & Lovett Grocery Co. reported for the quarter ended Sept. 20 sharply higher earnings, reflecting economies achieved through mechanization in warehousing and merchandise handling.

Net for the first quarter of the current fiscal year, totaled $600,597, or 44 cents a share on common, compared with $409,342 or 29 cents in the same quarter last year. Net sales of $41,851,672 compared with $36,763,499.

As of Sept. 20, the food chain had in operation 181 retail outlets [illegible] in Florida.

How To Make More Money

THIS NEWS CLIPPING suggests one way to make more money. Winn & Lovett's "sharply higher earnings" prove that a dollar saved is *still* a dollar earned.

"Mechanization" saved more than 50% of Winn & Lovett's handling bill. "Mechanization" in this case means a fleet of CLARK fork trucks and towing tractors, operated on a well-planned schedule. These savings, together with increased retail volume and retail operating improvements, resulted in "sharply higher earnings," and the company made financial headlines.

The moral of this story is this:

Call in your local CLARK dealer to discuss ways to cut handling costs. That's what Winn & Lovett did, and look what happened!

CLARK ELECTRIC, GAS, DIESEL, L.P. GAS **FORK TRUCKS**
AND POWERED HAND TRUCKS · INDUSTRIAL TOWING TRACTORS

INDUSTRIAL TRUCK DIVISION · CLARK EQUIPMENT COMPANY · BATTLE CREEK 88, MICHIGAN
Please send: ☐ Condensed Catalog ☐ Have representative call
☐ Driver Training Movie

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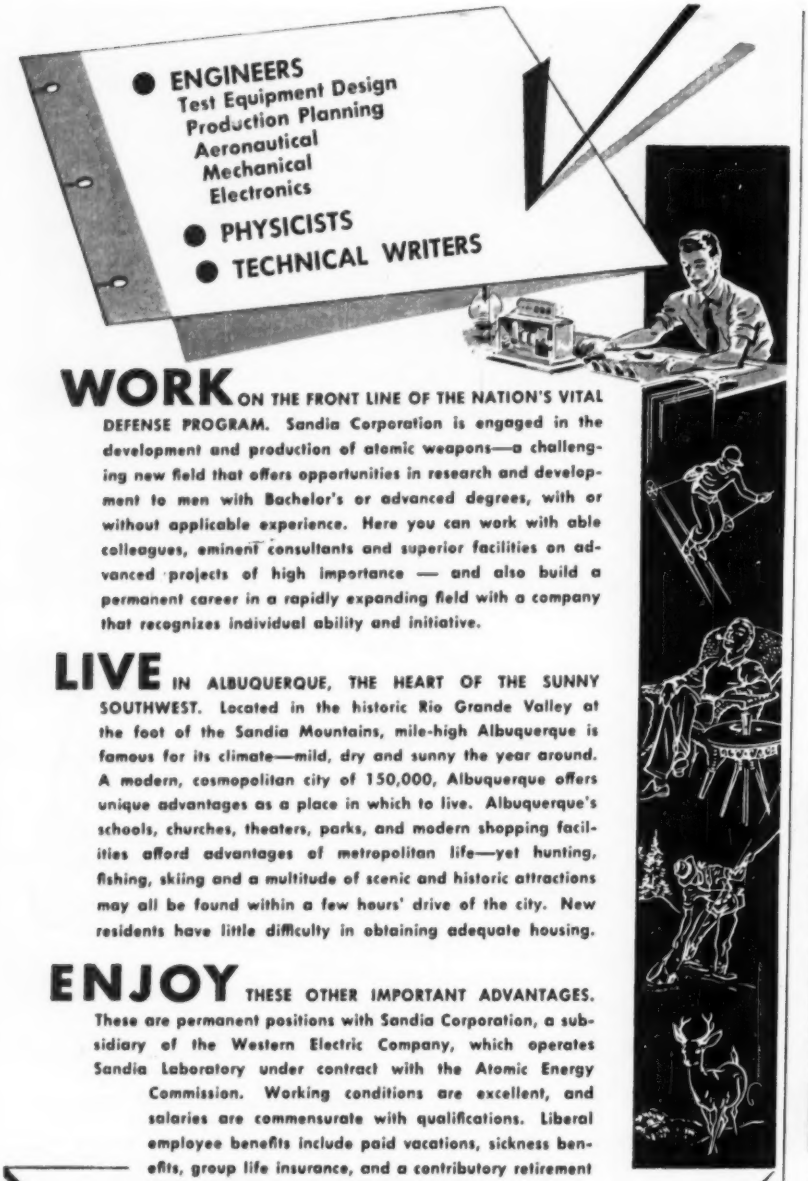
Firm Name _____
Street _____
City _____ Zone _____ State _____

AUTHORIZED CLARK INDUSTRIAL TRUCK PARTS AND SERVICE STATIONS IN STRATEGIC LOCATIONS



WORK ON THE FRONT LINE OF THE NATION'S VITAL DEFENSE PROGRAM. Sandia Corporation is engaged in the development and production of atomic weapons—a challenging new field that offers opportunities in research and development to men with Bachelor's or advanced degrees, with or without applicable experience. Here you can work with able colleagues, eminent consultants and superior facilities on advanced projects of high importance — and also build a permanent career in a rapidly expanding field with a company that recognizes individual ability and initiative.

LIVE IN ALBUQUERQUE, THE HEART OF THE SUNNY SOUTHWEST. Located in the historic Rio Grande Valley at the foot of the Sandia Mountains, mile-high Albuquerque is famous for its climate—mild, dry and sunny the year around. A modern, cosmopolitan city of 150,000, Albuquerque offers unique advantages as a place in which to live. Albuquerque's schools, churches, theaters, parks, and modern shopping facilities afford advantages of metropolitan life—yet hunting, fishing, skiing and a multitude of scenic and historic attractions may all be found within a few hours' drive of the city. New residents have little difficulty in obtaining adequate housing.

ENJOY THESE OTHER IMPORTANT ADVANTAGES. These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates Sandia Laboratory under contract with the Atomic Energy Commission. Working conditions are excellent, and salaries are commensurate with qualifications. Liberal employee benefits include paid vacations, sickness benefits, group life insurance, and a contributory retirement plan. This is not a Civil Service appointment.

Make Application to:

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DIVISION B

SANDIA *Corporation*

SANDIA BASE ● ALBUQUERQUE, NEW MEXICO

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

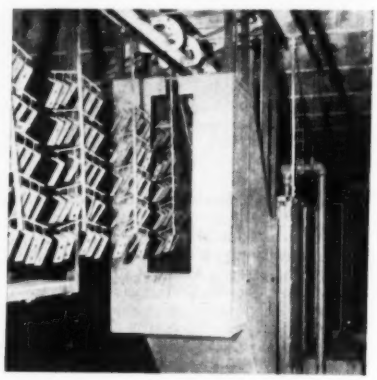
cells are mechanically and electrically interchangeable with standard cells; that is, they have the same nominal resistance, 120 ohms, their voltage output at rated capacity is the same, two millivolts per volt, and cells of a given capacity have the same physical dimensions. The essential difference between the classes of cells is the finer tolerances to which the cells are calibrated and temperature-compensated.

Applications of SR-4 load cells for electrical weighing include static weighing of storage tanks and hoppers, conveyors, aircraft, trucks, locomotives, freight cars, and automotive forces and loads. Thrust measurement of turbo-jets, ram-jet, turbo-prop, and powdered- and liquid-fuel rocket-propulsion systems have been made extensively by this equipment.

Drying Metal Parts

An inexpensive far-infrared electric heating installation has speeded up drying of metal parts for Unistrut Corp., Wayne, Mich., an announcement by Edwin L. Wiegand Co. reports. Twelve Chromalox electric radiant heaters rated at 1.8 kw each focus far-infrared heat on parts as they leave the washing and bonderizing tunnels.

With a conveyor speed of 6 ft per min, 3000 lb of brackets, angles, channels, clamps, and similar parts are dried per hour. Insulation



and reflective aluminum sheeting are used to retain heat in the oven as much as possible.

The escalator-type oven used here is said to be rather unusual, but well suited for the job being done. The all-metal radiant heaters are mounted at an oblique angle to assure even absorption of heat by the passing work.

Heat regulation for varying part sizes is provided by variable-input controllers and magnetic contactors. Controller settings can also be varied to compensate for changes in rinse temperature, ambient building temperature, and humidity.

More information about the application of Chromalox radiant heaters is available from Edwin L. Wiegand Co., 7646 Thomas Blvd., Pittsburgh 8, Pa.

Use a CLASSIFIED ADVERTISEMENT
for Quick Results

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Stainless-Steel Chemical Meter

Accurate volumetric measurement of corrosive products, including caustic soda, concentrated sulfuric acid, many other acids, ammonia, and fruit juices, is possible with the Niagara Chemical Meters manufactured by the Buffalo Meter Co., Buffalo, N. Y.

This meter in its modified and improved design operates on the same displacement principle that has been successfully time-tested in the measurement of many types of liquids. Type 316 Stainless Steel is used for all parts exposed to the liquid (instead of the bronze), except the measuring piston. Catalog is available from the Buffalo Meter Co., 2939-P Main St., Buffalo 14, N. Y.

RESEARCH ENGINEER

Man to coordinate research program for a large progressive company in the field of propulsion including reciprocating engines, gas turbines, unconventional power plants and propellants. Requires a man interested in research with experience in directing research programs in propulsion or related field.

All replies confidential.

Box ME 1730
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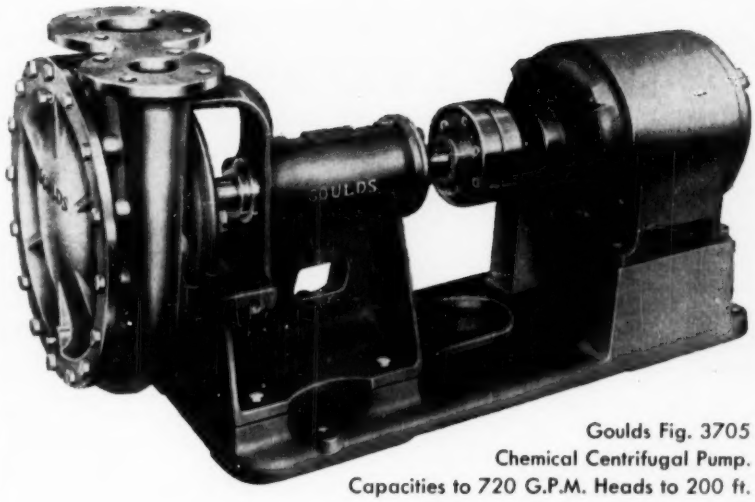

Goulds Fig. 3705
Chemical Centrifugal Pump.
Capacities to 720 G.P.M. Heads to 200 ft.

Now available in these 8 different materials!

You know the Goulds Fig. 3705 as the pump that is saving chemical plants thousands of dollars in handling corrosive liquids such as acids and alkaline liquors.

You've asked if it could be supplied in materials other than stainless steel 316 and FA-20. Here's the answer:

You can now take your choice of these eight different materials:

1. Stainless steel 316
2. Stainless steel FA-20
3. Stainless steel 304
4. All iron
5. All bronze
6. Bronze fitted
7. All iron, stainless steel trim
8. All bronze, stainless steel trim

And you can take advantage of these four saving benefits:

a. **Long packing life and freedom from leakage**—Stuffing box on suction side of impeller means pressure is limited to suction head.

b. **Easy cleaning and inspection**—Suction and discharge connections in casing permit removal of casing cover and impeller without disturbing piping.

c. **Impeller clearance adjustable for wear**—By loosening and sliding end cap along shaft you expose locking collar on outboard ball bearing, permitting you to readily adjust impeller position.

d. **Low parts inventory**—Interchangeable parts permit you to keep inventories down and prevent excessive down-time.

To get full information on these new materials, plus performance curves, specifications and dimensions, contact your nearby Goulds representative, or clip and mail the coupon for new Bulletin 725.3.

Goulds PUMPS INC. Seneca Falls New York

GOULDS PUMPS, INC.
Dept. ME, Seneca Falls, N. Y.

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Applications of cathode-ray oscillography

WELDING CURRENT vs. ELECTRODE DISPLACEMENT

Physical Setup: An electrostatic-stored-energy "Weldpower" welding control and associated welding head for resistance welding of non-ferrous materials.

The Problem: To correlate displacement of the welding electrode with the flow of welding current to determine the rate of "follow-up" (forging motion) during welding of copper and other non-ferrous materials.

The Solution: Both welding current and electrode position are plotted against time on a dual-beam cathode-ray oscillograph* operated with both channels on a common time base. The oscillograph sweep is triggered by external equipment which triggers the sweep shortly before the welding action to insure that the presentation will be in the center of the screen.

The welding-current waveform (A) is derived from the voltage drop across a high-current shunt. This voltage is proportional to the welding current and is fed to one channel of the cathode-ray oscillograph. At the same time a timing oscillator feeds 1000 cycle-per-second voltage pips into the z-axis of this channel to provide blanking marks at 0.001 second intervals.

A flag on the welding electrode partially interrupts a light beam as the electrode travels downward. The light beam is focused on a multiplier phototube. For the short electrode travel, the multiplier phototube output is proportional to the position of the electrode at any instant and this output is applied to the second channel of the cathode-ray oscillograph (B). The oscillograph screen was calibrated by static measurements of current and displacement.

In this test, a cross-wire weld was made on #18 hard-drawn, tinned copper wire. The oscillogram, taken with an oscillograph-record camera**, shows that the current (A) with 0.001 second timing marks imposed, rises to the 8000 ampere peak (1) in about 0.002 seconds. Waveform (B) shows that the metal to be welded became plastic at the peak current where the downward travel of the electrode began (2). After 0.004 seconds the metal solidified, electrode motion stopped (3) and the weld was completed. In this time the electrode traveled downward 0.025 inches (3). Variations in (B) following the completion of the weld result from slight mechanical oscillation in the welding head. This identical setup is used to plot the force exerted by the welding electrode during the welding cycle except that the displacement waveform (B) is differentiated twice (d^2s/dt^2) with very simple electrical circuits to derive force.

An application of cathode-ray oscillography by the Raytheon Manufacturing Company, Equipment Engineering Division, Waltham, Massachusetts.

*Du Mont Type 322 **Du Mont Type 297

DU MONT *for Oscillography*

For further information concerning the Du Mont instruments used in this application, contact:

ALLEN B. DU MONT LABORATORIES, INC.

Technical Sales Department • 760 Bloomfield Avenue, Clifton, New Jersey

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Packaged Brazing Rings

A new method of packaging pre-formed brazing rings to speed up production brazing and to eliminate costly waste from bent ends and tangling has been announced by Alloy Ring Service, Inc., of Indianapolis, Ind.

The packaging method supplies the precision-made rings fitted on a cardboard tube or dowel rod.

Alloy brazing rings are being used extensively by Servel, Inc., manufacturers of domestic and industrial refrigeration and air-conditioning equipment. Alloy precision-formed rings are claimed to be free of burrs and to possess perfect fit.

Alloy Ring Service, Inc., manufactures commerical silver alloys, copper, and soft solder. A complete catalog of Alloy brazing supplies is available upon request. The company also offers advice and technical assistance on problems in brazing operations. Details may be obtained from Alloy Ring Service, Inc., 1095 East 52nd St., Indianapolis 5, Ind.

BUSINESS NOTES

Emsco To Make Ball Bearing Swivel Fittings

In a trend to wider diversification of the Emsco line of oil field and related products, the addition of a swivel-fitting department has been announced by William T. Powell, president of Emsco Mfg. Co.

Emsco has acquired the swivel-fitting business of the Rasmussen Mfg. Co. of Hollydale, Cal. These fittings, formerly sold by them under the trade name Ramsco, will be known as Emsco Swivel Fittings.

Heading up the swivel fitting sales program will be E. R. (Pop) Atkins, with headquarters at the Los Angeles plant of Emsco.

New Foote Bros. Office on West Coast

Foote Bros. Gear & Machine Corp., Chicago, Ill., has opened a new branch office for sales and service in California. It is located at 3529 Firestone Blvd., Southgate, a suburb of Los Angeles, and is under the direction of Robert E. Utermohlen.

In addition to producing all types of commercial gearing, Foote Bros. has facilities for the manufacture of special, large-size gears and Duti-Rated Lifetime Gearing.

Foote Bros. also makes a complete line of parallel shaft, straight-line, and right-angle speed reducers for heavy-duty applications, horizontal or vertical.

Hyatt Bearings Expands

Hyatt Bearings Div. of General Motors Corp. in Harrison, N. J., has announced that, for the first time, its exclusive self-aligning Barrel Bearing is available in volume quantitities for general industrial applications.

The recently expanded Hyatt Bearings Plant at Clark Township, N. J., will provide the additional facilities for expanded production. The new Clark Township Plant is described by Hyatt as one of the most modern bearing plants in the world.

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Buchanan Represents US Gasket in Houston

With the dissolution of Rowan and Buchanan, former representatives of the United States Gasket Co. in the Houston area, USG has elected to continue with the newly formed Wm. C. Buchanan Co. of 4101 San Jacinto St., Houston 4, Texas.

Reliance Electric Expands

A further expansion by the Reliance Electric & Engineering Co., Cleveland, Ohio, in its engineering and technical service facilities on the West Coast will include the establishment of a direct factory sales office in San Francisco and additions to its engineering personnel in both San Francisco and Los Angeles, it has been announced by E. E. Helm, sales vice president.

The new sales office will serve accounts in northern and central California and northwest Nevada, including those formerly served through the offices of the Fred G. Guthrie organization of San Francisco.

SPS Fiftieth Anniversary Book

The Standard Pressed Steel Co., Jenkintown, Pa., has contributed something new to the evolution of industrial anniversary volumes by not paying much attention to the past in its 50-year book. Entitled "50 Years —A Start for the Future," the book does not show pictures of the first plant, officers in sideburns and a worried look, or relics of the early days.

Standard Pressed Steel produces socket-head screws, dowel pins, pressure plugs, locknuts, specialty parts for the aircraft industry and others, and shop equipment.

In text and some 60 pictures, the golden anniversary book shows the company in operation, reveals its policies, practices, and purposes in sections devoted to its employees, its products, and its progress.

A score of pictures, showing a cross section of the products of American industry, suggest the extensive application of SPS fasteners.

Sheffield To Handle Cavitron Machine Tools

The Sheffield Corp., Dayton, Ohio, will henceforth design, manufacture, and market Cavitron machine tools, according to a joint announcement by the Cavitron Corp., Long Island City, N. Y., and Sheffield. In addition to Sheffield's exclusive distribution rights for the United States and Canada, both concerns will join in marketing the machines abroad. The agreement provides that the Cavitron Corp. will continue to produce the ultrasonic transducers and generators, being the originators of the ultrasonic machining process and holders of the basic patent rights, and will issue licenses for the process through Sheffield.

The Cavitron machine tool utilizes an ultrasonic vibrating head and an inexpensive tool, such as soft steel, for the precision cutting of hard and brittle materials, either ferrous or nonferrous, such as the carbides, germanium, hardened tool steels, sintered aluminum oxide, quartz, industrial crystals, ferrites, various types of glass, ceramics, and sapphire.

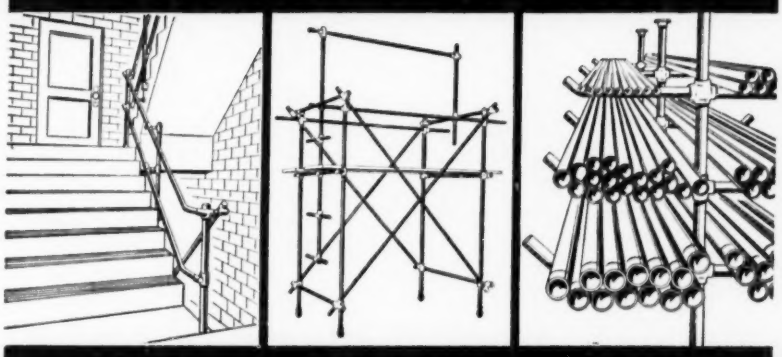
Turbine Equipment Co. Acquires Hynes Electric Fluid Heaters

Turbine Equipment Co. New York City, has announced the formation of its Hynes Electric Heating Div., for engineering, manufacturing and sales of Hynes industrial electric-heating equipment. Lee P. Hynes, who developed the equipment, will be retained as electrical and mechanical consulting engineer.

Hynes equipment includes tubular, multipass, and other types of electric heaters for general plant services such as fuel-oil heating, tank heating, air convection-heating, and lubricating oil purification by centrifuging, and also for such special-process applications as heating viscous or inflammable liquids in equipment, vessels, and pipe lines to speed up and improve processes in chemical plants and plants of textile, paper, rubber, paint, plastics, metal-working, and other industries.

Structural Uses for
ALCOA ALUMINUM PIPE

Quickly, easily assembled with Hollaender Slip-On Fittings of Alcoa Aluminum. Other types of fittings also available.



RAILINGS SCAFFOLDS RACKS

Advantages of Alcoa Aluminum Pipe:

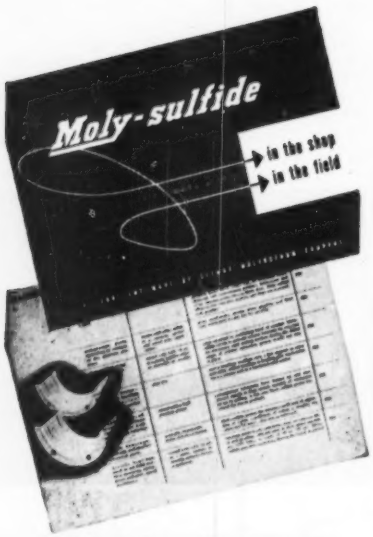
1. **RESISTS CORROSION**—Withstands most contaminated atmospheres without painting.
2. **STRONG**—Has excellent mechanical properties.
3. **LIGHT**—Schedule 40 aluminum weighs *one-third* as much as schedule 40 steel.
4. **ECONOMICAL**—Requires little or no maintenance.
5. **BRIGHT AND CLEAN**—Modern, good-looking appearance.

Most Alcoa distributors and jobbers stock structural pipe and fittings in standard sizes, but Alcoa can supply other sizes to your specifications. Consult your local Alcoa Sales Office or write: ALUMINUM COMPANY OF AMERICA, 903-M Alcoa Bldg., Pittsburgh 19, Pa.

Alcoa Aluminum

ALUMINUM COMPANY OF AMERICA

154 ideas on ways to use...



154 varied applications of molybdenum sulfide in the shop and in the field are described in a new booklet now available. This solid-film lubricant has demonstrated unique anti-friction properties under conditions of extreme pressure, high velocity, elevated temperature, or chemical attack.

The 40-page booklet contains the records of solved lubrication problems — some might solve your own.

Moly-sulfide
A LITTLE DOES A LOT

The lubricant for extreme conditions

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NEW EQUIPMENT
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Spring Production in Transit

A busy spring coiling machine hardly skipped a beat in recent moving operations at Seaboard Coil Spring Div. of Associated Spring Corp. Operated in transit by a small gasoline engine, the machine kept producing torsion coils for television tuners as it continued on its way by trailer from the former Seaboard plant at Los Angeles to Seaboard Div.'s new plant at 15001 S. Broadway, Gardena, a section of Los Angeles County. The new buildings, totaling 90,000 sq ft, also contain a hot-wound spring department in addition to the regular types of mechanical springs. Seaboard is the newest of the ten divisions of Associated Spring Corp. located throughout the United States and Canada.

LATEST CATALOGS

Industrial Fans

Aerovent Fan Co., Inc., has published a 64-page illustrated guide to modern industrial ventilation and air movement, contains engineering, installation, and operating data for standard and special-duty fan applications. Pertinent details for calculating duct sizes, friction losses, performance, and horsepower requirements are given. Specifications and descriptions of all Aerovent Fans and accessory equipment are included.

Copies can be obtained from Aerovent Fan Co., Inc., 720 East Ash St., Piqua, Ohio.

Flexible Metal Hose, Expansion Joints, Instrument Bellows

Flexonics Corp., formerly Chicago Metal Hose Corp., has released two publications on its products.

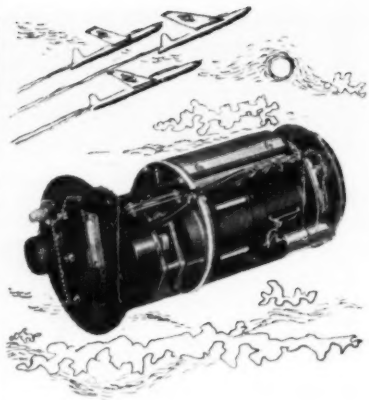
A two-color 16-page product design catalog, Catalog CMH-132, on flexible metal hose and instrument bellows is pointed specifically to uses of these products by original equipment manufacturers.

The bellows section features specifications and includes detailed information on Flexon stainless steel, brass, and bronze bellows, bellows assemblies, and bellows devices. The hose section features specification and application data on convoluted and corrugated types of flexible metal hose, as well as details on flanges, couplings, and other fittings. Also included are CMH special-purpose hose assemblies, and installation instructions.

An illustrated eight-page bulletin, Catalog No. 133, describing the Flexon line of expansion joints presents basic data necessary to the proper selection and application of pipe-line expansion joints.

Highlights of the bulletin include a discussion of types of pipe-line motion frequently encountered, and methods of handling this motion. Also covered are complete specifications for low- and high-pressure units, and detailed information on special types of joints including Flexoniflex, good for pressures to 5500 psi. A section deals with the proper guiding and anchoring of expansion joint installations.

Requests for either of the above catalogs should be addressed to Flexonics Corp., 1305 S. Third Ave., Maywood, Ill.



Methods, process engineers . . .

Interested in flying *HIGH*— on a new job?

The automatic altitude control above, engineered at Honeywell, holds aircraft at any desired altitude — from sea level to 50,000 feet.

You can work on such interesting automatic control projects — if you join Honeywell.

And right now we have several openings for experienced engineers who are interested in flying high on a new job that offers almost unlimited opportunity.

Duties of the jobs. Supervise the tooling, processing and planning necessary to transform blueprints into finished products.

Requirements. B.S. or M.S. in Mechanical, Electrical, Industrial or Chemical Engineering desirable.

Atmosphere. A company which is growing rapidly, steadily and soundly. The challenge of production is ever present.

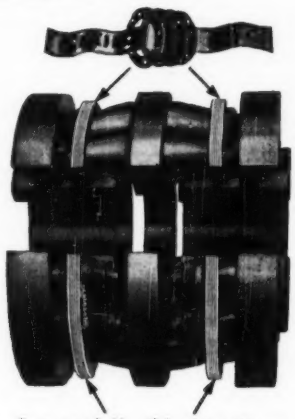
Openings. In Minneapolis and Philadelphia.

Write J. A. Johnson, Engineering Placement Director, Dept. ME-12-184, Honeywell, Minneapolis 8, Minnesota. Learn in detail about the significant opportunities at Honeywell. And be sure to ask for our new book, "Emphasis on Research."

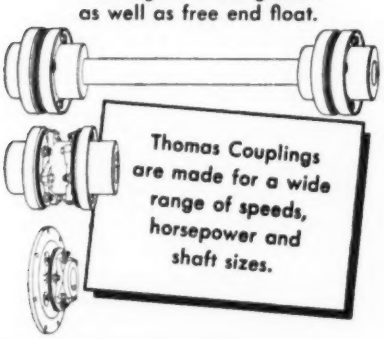
MINNEAPOLIS **Honeywell**
First in Controls

Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs

DISTINCTIVE ADVANTAGES	
FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.



Thomas Couplings are made for a wide range of speeds, horsepower and shaft sizes.

THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT

NO MAINTENANCE PROBLEMS

ALL PARTS ARE SOLIDLY BOLTED TOGETHER

Write for our new Engineering Catalog No. 51

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

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Product Research

A new brochure, "Product Research," Bulletin A, dealing with the development of new products, improvement of an established product or the method of producing it, and discovering new uses for it or a better raw material for it, is available by writing to Arthur D. Little, Inc., 30 Memorial Dr., Cambridge, Mass.

Electronics Equipment

A 16-page summary of equipment available for use in the electronics industry can now be obtained from the Westinghouse Electric Corp. The booklet gives descriptions, applications, and operating ranges for such equipment as surge comparison testers, portable balancers and vibrographs, magnetic amplifiers, transistors, capacitors, and relays. Although devoted largely to that kind of finished equipment, the booklet also gives information on such semi-finished material as transformer cores and magnetic materials and alloys.

Designed primarily to give users an idea of what equipment is available, the booklet also gives brief technical data. For a copy of this booklet, B-6093, write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Variables Measured by Capacitance

How to determine the level, weight, displacement, composition, thickness, moisture, and other previously unmeasurable characteristics of difficult fluids and solids is explained in a new series of Technical Information Sheets issued by The Foxboro Co. of Foxboro, Mass. Based on practical industrial uses of Foxboro Capacity Dynalog Instruments, the data show the application of capacitance measurement to processes which cannot be measured by conventional means.

Measurements of composition and level are explained in detail. To test product quality in a flow line, the instrument is calibrated in terms of chemical properties such as percentage of acetic acid in acetic anhydride, or the percentage of toluene in hexane. For level changes of fluids such as HF acid or chlorine, the instrument measures the dielectric constant between a probe and the tank wall, which act as the two plates of a capacitor. Also measurable is the interface level between two dissimilar fluids such as hydrocarbon and water, which produce changes in dielectric as the interface level changes.

Another section covers applications involving mechanical motion and position, such as dimensional measurement of sheeted plastic, fabric, and paper, or the angular deflection of a rotating spindle used in measuring the viscosity of foods and other products. By a system of linkages, the rotor of an air capacitor varies the capacitance in proportion to the variable being measured.

Also described is the Dynalog Sheet Weight Recorder, used to measure the thickness of plastic sheets and to weigh tire cord fabric and rubber gum stocks. Weight or thickness is determined by passing the sheet stock through a measuring head which responds to the dielectric properties, and hence weight or thickness, of the material.

Instrument data and circuit diagrams are also featured in the Technical Information Sheets, copies of which will be sent on request.

BRIDGING THE COUNTRY

THE SUPERIOR BRIDGE DECKING FOR SMALL OR LARGE JOBS

- ★ 80% OPEN
- ★ SELF-CLEANING
- ★ SELF-DRAINING
- ★ NON-FLOAT
- ★ NOT AFFECTED BY WIND PRESSURE
- ★ LIGHT WEIGHT
- ★ STRONG, SAFE ROAD SURFACE
- ★ MINIMUM OF ROAD MAINTENANCE

IRVING DECKING

"A BRIDGE IS ONLY AS GOOD AS ITS DECK"

- Also gratings for bridge sidewalks and gutter catch basins.
- No accumulation of dirt or snow.
- For further information and engineering data ask for catalog.

IRVING SUBWAY GRATING CO., INC.
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1810 10th St., Oakland 20, California

Industry looks to
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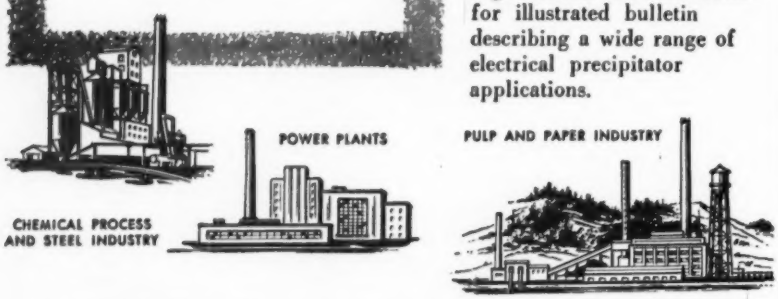

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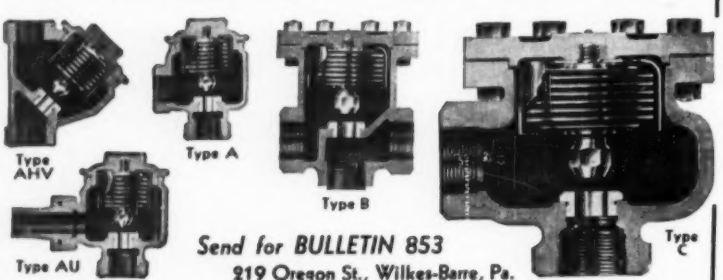

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Ultrasonic Cleaning

How the ultrasonic generator works, the principles of high-frequency sound cleaning, and examples of present applications are explained in a new bulletin announced as available from the General Electric Co., Schenectady 5, N. Y.

Designated GEA-6056, the two-color, four-page publication explains how the ultrasonic action of the generator hastens cleaning by as much as 100 times. Photographs and drawings show components of the equipment and the generator in use.

Boiler Burners

A new 16-page catalog, No. 5052, on Iron Fireman horizontal rotary oil burners, combination oil-gas burners, and forced-draft packaged burners for oil and combination oil-ga firing, has been issued. Illustrations and text cover features of the burners, including Oil Volumeter, prewired control panels, ignition system, oil pre-heating apparatus, and forced-draft equipment. The catalog contains numerous cutaway illustrations and full data on models and capacities. Copies are available, at no charge, from Iron Fireman Mfg. Co., Cleveland 11, Ohio.

Grinding Cemented Carbides

A booklet entitled "Grinding Cemented Carbides," 39 pages, illustrated with diagrams and photographs, describes techniques and abrasive products developed to obtain efficient and economical carbide tool manufacture and maintenance.

Included are appraisals of the advantages and limitations of the use of green grit and diamond grinding wheels. Wheel recommendations covering many specific grinding applications are also included.

The booklet is free of charge from The Carborundum Co., Niagara Falls, N. Y.

Magnetic Brake

A four-color leaflet on its magnetic brake is being distributed by the Reuland Electric Co. Emphasis is on the simplicity and speed of the magnetic-brake operation. Among the other features briefly covered are: single- or double-end shaft, manual release with automatic reset, smaller size, automatic lining wear adjustment, gear-type hub, one-piece housing, NEMA "C" face- or foot-mounted types, and availability in 3, 6, 10, 15, and 25 ft-lb continuous-duty ratings or 3, 6, 10, 15, 25, and 35 ft-lb intermittent-duty ratings.

Copies are free from Reuland Electric Co., Alhambra, Cal.

Ultrasonic Testing Device

The Sperry Ultrasonic Reflectoscope, a non-destructive testing instrument used to test metals and other materials for surface and internal defects, is described and illustrated in Bulletin 50-105. The Reflectoscope produces pulses of ultrasonic sound waves which are transmitted into the material and reflected back by any discontinuity, whether in the material or on the opposite side.

Two pages of photographs show uses of the Reflectoscope with raw materials, manufacturing operations, finished products, and preventive maintenance. Principles, advantages, applications, technique, the variety of search units, specifications, and accessories are described in the eight-page booklet, which is available on request from Sperry Products, Inc., Danbury, Conn.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Cathode-Ray Oscillograph

The Allen B. Du Mont Laboratories, Inc., Instrument Div., offers to interested engineers "The Oscillographer," a publication devoted to the uses and developments of the cathode-ray oscillograph. Vol. 14, No. 1, contains the third part of a three-part article on "Function and Design of Transducers for Oscillography." Several new items of equipment are also listed and described. Vol. 14, No. 2, features part one of an article "Techniques in Pulse Measurements." Copies are available from the Instrument Div., at 760 Bloomfield Ave., Clifton, N. J.

Non-Destructive Test Techniques

In Bulletin SK-2, Schutte & Koerting Co., manufacturer of high-pressure, high-temperature equipment for the power, chemical, petroleum, food, and allied fields, tells how new non-destructive testing equipment and techniques and a sound quality control program are helping to provide equipment to meet ever-increasing pressure and temperature requirements.

The booklet pictures and describes the operation of the company's quality control program, and explains the equipment and techniques used. Among the methods mentioned are hydrostatic, pneumatic, temperature shock, polariscope, magnetic particle, and radiographic (x-ray and cobalt 60) testing and inspection. Magnetic particle and radiographic techniques are described in detail.

Copies of Bulletin SK-2 can be obtained by writing to: Schutte & Koerting Co., Dept. A-A, Cornwells Heights, Bucks County, Pa.

Testing Instruments

The Statham Development Corp. has published two equipment bulletins and a technical-paper reprint.

The bulletins cover Statham's Rotary Accelerator, which provides a controlled variable centrifugal acceleration for calibration or testing, and the Model TC-1 Temperature Test Chamber, for the performance of ambient temperature variation tests from −65 F to 275 F. The paper, "Pressure-Sensing Calculations for Aircraft and Guided Missiles," by J. D. Humphreys, Northrop Aircraft, Inc., is printed as the June, 1953, issue of *Instrument Notes*, Statham's periodical.

Copies of these publications may be obtained from Statham Development Corp., 12401 West Olympic Blvd., Los Angeles 64, Cal.

Water Demineralizing

A 39-page booklet on treating water by demineralizing it now is available from the Cochrane Corp., Philadelphia, Pa., manufacturer of water-treating systems.

This "Handbook on Demineralizing" explains the principles of ion exchange. Applications of many anion and cation exchange materials are discussed. A series of curves enable estimates of cost of operation of such systems to be prepared. The design and operation of demineralizer systems, both multi-stage systems and mixed-bed units, are described, and curves of water quality obtainable from the various systems are included. Operating results and flow diagrams of several existing plants are shown.

Copies of this handbook, Bulletin 5800, may be obtained from the Cochrane Corp., 17th St. below Allegheny Ave., Philadelphia 32, Pa.

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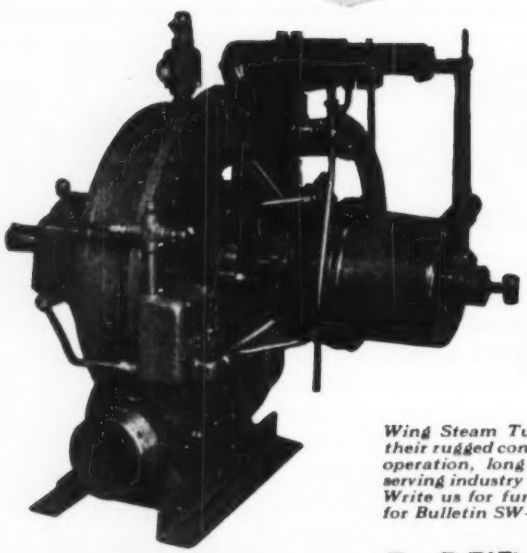

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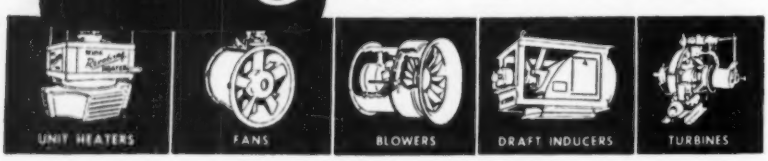

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Furnace and Induction Brazing

The advantages of furnace and induction brazing are told in a picture-story case-history technique in a bulletin announced as available from the General Electric Co., Schenectady 5, N. Y.

Designated GEA-5889, the 12-page, two-color booklet is the latest in the Company's series on modern metal processing. Examples include cases where furnace brazing has replaced casting, forging, machining, and welding of parts; and where induction brazing has replaced torch brazing, soldering, and riveting.

Corrosion-Resistance of Austenitic Steels

"Corrosion-Resisting Properties of the Austenitic Chromium-Nickel Stainless Steels," Bulletin A-49, 32 pages, 18 tables, shows the results of tests on numerous austenitic stainless steels in various solutions, acid, neutral, and alkaline. The booklet is a general publication that covers: the mechanism of corrosion resistance in stainless steels; factors affecting their corrosion; their behavior in various corrosive environments, marine and industrial atmospheres, in organic and inorganic acid salt solutions, and in halogen salts and weak and strong bases; and the preferred practice in construction and use of stainless steels. It is shown that nickel in combination with chromium increases the corrosion resistance in both oxidizing and reducing solutions. In addition it has desirable effects in promoting austenitic structure and maintaining it during and following fabrication. Copies are available from the International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Load Center Substation

Questions relating to the selection of a load center unit substation to meet specific power requirements are answered in a 24-page bulletin released by Allis-Chalmers Mfg. Co.

The bulletin explains what a load center unit substation is, how substations at load centers can help improve low voltage caused by heavily loaded feeders, and how they can be placed indoors or outdoors near the load.

The selection of proper protective equipment for a specific system is also covered in the bulletin along with information on four types of available transformers: oil filled, sealed dry type, open dry type, and Chloroextol liquid filled. Size and dimension tables show how much space load center unit substations require and nomograms are given to help in selecting the proper size breaker. The concluding pages of the bulletin provide data to indicate how a typical specification for a 750-kva dry type load center unit substation appears when it is completed.

Copies of the bulletin, "Power At Load Centers Pays Off," 11B6285B, are available on request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

For Consulting Engineers
Turn to Page 134

KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Vacuum Printer

A new four-page two-color brochure published by Peerless Photo Products, Inc., Shoreham, Long Island, N. Y., describes in detail the design and operating principles of this manufacturer's new "Magic Hand" vacuum printer.

The Magic Hand is a lightweight, flexible rubber blanket which replaces the conventional heavy, rigid lid of other vacuum printers. In operation, this blanket is said to simulate the action of the human hand in smoothing down the material to be copied and holding it firmly in position against the glass for perfect register. The Magic Hand blanket squeezes out the air as it rolls down over the material when the lid of the printer is lowered, and the vacuum can therefore be drawn more rapidly and with very little pressure on the lid, according to Peerless.

Another feature of the Peerless Magic Hand printer described in the brochure is its three separate lighting systems: white, for ordinary printing; yellow, for reflex printing; and ultra-violet, for very dense negatives and its automatic exposure control. Specifications for the three sizes of Peerless' Magic Hand printers, included in the brochure, give print areas 38 × 50 in., 44 × 74 in., and 50 × 98 in. as available. Copies of the new brochure are available free on request from Peerless Photo Products, Inc., Shoreham, Long Island, N. Y.

Weld Standards

To enable the engineers of machinery manufacturers and fabricators to acquire both cost and quality control over welding operations, The Lincoln Electric Co. of Cleveland, Ohio, has created and is making available a set of Weld Standards. The Standards are available on tracing paper so that they can be blue-printed or otherwise reproduced. The weld Standards are based on procedures developed by Lincoln and the weld symbols of the American Welding Society.

The Weld Standards, with a letter designation, specify according to plate thickness both the type and size of weld as well as how it should be made.

For a specified thickness Weld Standards give the electrode type and size, the polarity and current, electrode melt-off rate, arc speed, number of passes or beads, feet of joint welded per hour, and the pounds of electrode required per foot of weld. All of these factors are specified by using the Weld Standard designation in conjunction with the regular American Welding Society symbol. Standards have been prepared for manual welding of butt welds, fillet welds, and lap and corner welds in all positions in both plate and sheet metal.

Complete sets of 19 sheets on tracing paper in a loose-leaf binder are available from The Lincoln Electric Co., Cleveland 17, Ohio, for $1.00 per set, postage prepaid in USA; $1.50 elsewhere.

Refrigeration Manual

A revised edition of the Trane Refrigeration Manual has been published by The Trane Co., La Crosse, Wis., manufacturer of heating, air conditioning, and ventilating equipment.

The manual gives information on installation, operation, and servicing of refrigeration equipment for contractors and servicemen. The latest edition of the Trane Refrigeration Manual contains two new chapters on refrigeration piping. Other changes include a new chapter on refrigeration system control, a revised chapter on service operation, and a completely revised refrigeration system service analysis chart.

The manual begins with a discussion of refrigerants and the refrigeration cycle. Succeeding chapters give detailed information concerning the selection, installation, and servicing of all the component parts of refrigeration systems, including evaporators, compressors, condensers, thermostatic expansion valves, refrigeration system control equipment, motors and motor control equipment, heat exchangers, dryers, valves, piping, and accessories. The text is illustrated with photographs, drawings, charts, and graphs.

Now in its ninth printing since it was first published in 1946, the manual has also been used as an educational text and source reference on refrigeration by colleges and industries. The revised, 125-page manual can be purchased from The Trane Co., La Crosse, Wis., for $1.50.

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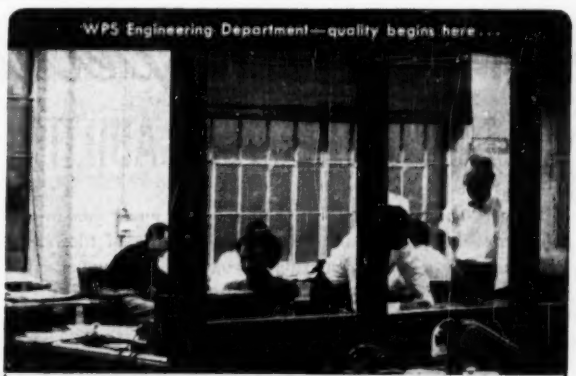

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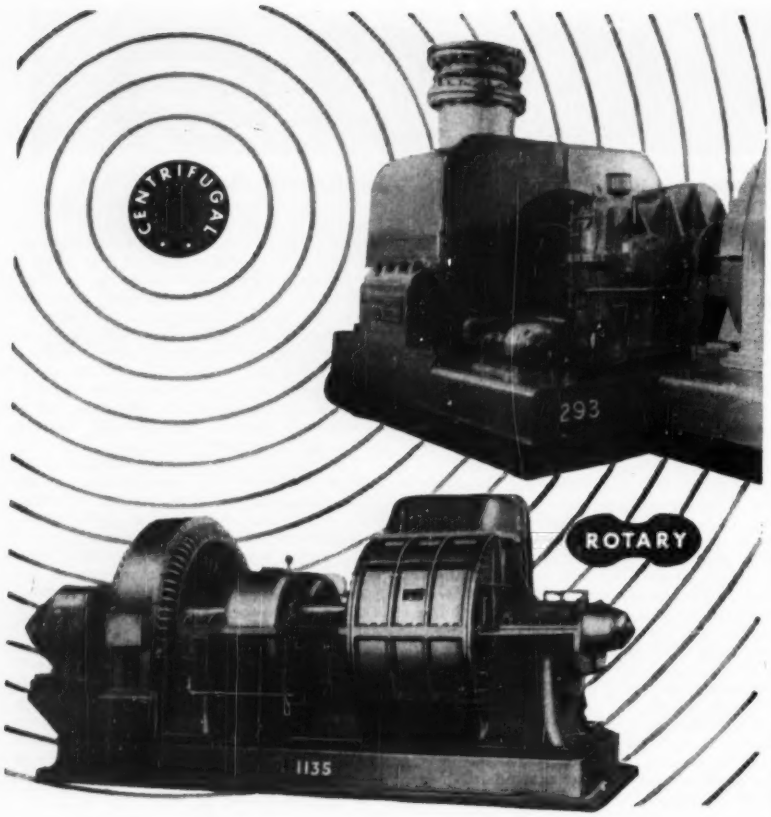

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In addition to blowers and exhausters, R-C products include a wide range of gas and vacuum pumps, meters, inert gas generators and other related equipment. So, whenever you have a need for moving or measuring gas or air, we suggest consultation with the R-C Specialists.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Solenoid Pilot-Operated Control Valves

Bulletin SK-53, describing the line of Valvair "Speed King" solenoid pilot-operated control valves has been published by the Valvair Corp., 454 Morgan Ave., Akron 11, Ohio. The general design features and advantages of the valve are explained and specifications for the individual types of valves are given. Types included are 3-way foot-mounted, 3-way sub-base manifold-mounted, 4-way foot-mounted, 4-way sub-base manifold-mounted, and 4-way 5-port sub-base manifold-mounted. The bulletin will be sent for the asking.

Lignite-Burning Power Station

An article on a pulverized-lignite-burning power plant, the William J. Neal Station, Central Power Electric Cooperative, Inc., North Dakota, is featured in the Summer, 1953, issue of the *Alco Products Review*. Equipment and operation of the plant are discussed. Other articles in the issue are "Cellulose Production Expanded in Canada," "New Cooling System for the Nation's Capital," and "Mass Spectrometer Insures Leak-Proof Welds."

Alco Products Review is published quarterly by the Alco Products Div. of the American Locomotive Co. and is available on request from the company's Public Relations Dept., Schenectady 5, N. Y.

Cast Elevator Buckets

Link-Belt Co. has released a 12-page Book No. 2465 on its complete line of cast malleable and Promal elevator buckets, including Styles A, AA, AA-RB, B, C and Continuous, for handling such diverse materials as coal, coke, ores, grain, cement, chemicals, pulp, clay, sugar, and salt.

The buckets are smooth and seamless, with rounded corners to promote easy discharge. Corners are reinforced for added strength. All buckets can be punched for assembly on belts or chains.

Fifty-five standard sizes are listed. Tables give dimensions, weights, and capacities. Detailed information is provided on the mounting of buckets on belts and chains, with tables and diagrams on bucket punching. Various chain attachments and elevator bolts are illustrated. A copy of Book 2465 will be furnished by Link-Belt Co. 307 N. Michigan Ave., Chicago 1, Ill., on request.

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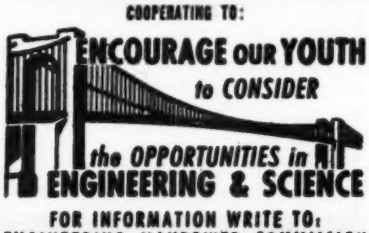

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Pulverized Fuel Systems

Bulletin BP-53-3, "Pulverized-Fuel Systems," 32 pages, describes Foster Wheeler ball mill pulverized-fuel systems. A general explanation of the system's operation is given, together with the advantages of the Foster Wheeler ball mill. Each of the components is then discussed and diagrammed, and the booklet concludes with a summary of seven typical installations. Numerous photographs and cutaway views of pulverized-fuel systems are included.

The bulletin may be obtained from Foster Wheeler Corp., 165 Broadway, New York 6, N. Y.

Ferrous and Nonferrous Tubing

The announcement of a new complete "Statement of Scope" has been made by H. A. Harty, advertising manager of Wolverine Tube Div., Calumet & Hecla, Inc.

The 12-page, pocket-sized booklet is presented for convenient reference to Wolverine Tube Div., products, their range of sizes, lengths, and tempers available, as well as a complete scope of their facilities. Also featured are listings of individual product literature available and locations of Wolverine sales offices and plants. Wolverine manufactures ferrous and nonferrous tubing for a wide variety of uses.

Copies of this "Statement of Scope" may be obtained by writing Wolverine Tube Div., 1419 Central Ave., Detroit 9, Mich.

Carbide-Tipped Tools

The Nelco Tool Co., Inc., has published Bulletin No. 53, a concise listing of their line of carbide-tipped machine tools. Side milling cutters, slab mills, face mills, taper shank end mills, shell end mills, tri-helix side milling cutters, slitting saws, fine-pitch face mills, tri-helix face mills, shell milling cutter arbors, twist drills, drills for hardened steel, grinder and lathe centers, and end mills are covered. Photograph of each tool is shown, together with tables of dimensions and available sizes. The six-page folder is available on request from the Nelco Tool Co., Inc., Manchester, Conn.

Engineering Formulas & Tables

Lefax' newly revised "Engineering Formulas & Tables" contains 350 pages of basic formulas, design data, and tables for the three branches of engineering. Twelve division sheets with printed tabs furnish access to the particular information desired. The book is priced at $2.75. Sections include Mathematics, Measures, Materials, Gages, Screws, Mechanics, Electricity and Magnetism, Hydraulics, Structural Data, Reinforced Concrete, Pipe and Fittings, Steam Tables, and Mathematical Tables. A free copy of Lefax Catalog is available on request, giving over 2000 listings of technical data books in pocket size, from Lefax Publishers, Phila. 7, Pa.

High-Power Audio Amplifier

A bulletin describing the new type FG 5- or 10-kw variable-frequency audio amplifier is available from the Westinghouse Electric Corp. Applications of the amplifier are suggested. The type FG audio amplifier will amplify 30- to 10,000-cycle signals as much as a million times.

Design and construction features of the equipment are discussed, and operation is described. Electrical characteristics of the amplifier are included. A copy of this descriptive bulletin, DB 85-950, will be sent on request from Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Dripproof, Enclosed, and Gear Motors

The recently announced G-E line of Tri-Clad "55" motors, built in 1–30-hp ratings to latest NEMA dimensions, are described in three new four-color picture-story bulletins available from the General Electric Co., Schenectady 5, N. Y.

The publications contain descriptions of new maintenance, performance, and protective features of the line, and each includes a double-spread cutaway drawing of the motors. A 16-page booklet, GEA-6013, covers dripproof models; enclosed motors are presented in GEA-6012, an 8-pager; and 14-page bulletin GEA-6027 describes the new gear motors. Tri-Clad "55" will be available in large quantities after January 1, 1594.

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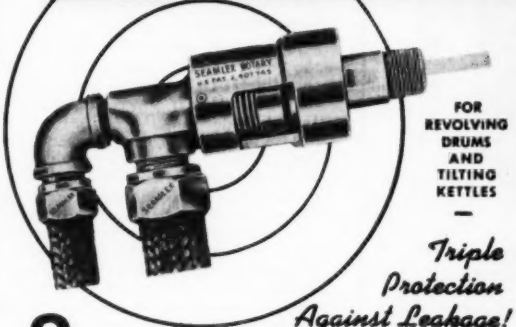

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Blast Cleaning

Pangborn Corp. offers the 32-page "Blast Cleaning," by Victor F. Stine. The booklet is an outline of blast-cleaning processes, describes machines for various types of work, and analyzes airless compared to air blast. Economies of automatic machines and the advantages of various types of abrasives are discussed. A comprehensive list of applications is furnished along with a glossary defining the terms used in this nontechnical text book.

"Blast Cleaning" is available on request from Pangborn Corp., Hagerstown, Md.

Speed Measuring by Resonance

Bulletin 31-P8 deals with the measurement of speed by resonance or vibration. The description of this phenomenon declares a series of tuned steel reeds can indicate speeds more accurately than most mechanical tachometers and speed indicators.

Because of the lack of direct coupling, there is no maintenance involved and no moving parts to be lubricated or to wear out.

Removal of housings or end plates is unnecessary for speed measurement.

Bulletin 31-P8 describes the principle of operation and gives applications. It is available on request from James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.

Also available is Bulletin 35-65, covering the Dr. Horn precision hand tachometer, which offers six measuring ranges between 25 and 30,000 rpm.

Water-Tube Boilers

Erie City Iron Works describes its Type C three-drum boiler in a revised catalog. This water-tube boiler claims large water-holding capacity, fast steaming, large steam-relieving surface, and the production of superheated steam from a standardized design. A unique method of steam take-off through a bank of tubes into a header is said to eliminate moisture carry-over. A comprehensive description of these features is contained in Catalog SB-49, Erie City Iron Works, Erie, Pa.

Prevention of Bin Stoppage

PneuBin pulsating panels are described in a bulletin as "the only device that feeds materials uniformly, noiselessly from bins and hoppers by positive displacement." The panels are composed of a flexible neoprene diaphragm bonded to a steel plate, which is mounted on the inside of the bin. Air is alternately admitted and exhausted between the steel plate and the diaphragm, causing the panel to pulsate. This action of the panels is claimed to prevent arching and funneling.

PneuBin Panels are made in ten standard sizes, from 3 in. to 24 in. in width and 6 in. to 72 in. in length. Special sizes can be made. Descriptive literature and more information can be obtained from Gerotor May Corp., Baltimore 3, Md.

Welding Fluxes

Krembs & Co. have issued a new bulletin and price list on their various fluxes. Twenty-six different Fluxine Fluxes are described, with their particular use in welding steel, aluminum, silver, etc. Included is the new 28H Fluxine in powdered form for gas, hydrogen, argon, or heliarc welding of stainless steel and Inconel, and Fluxine No. 47, which is used for silver soldering on steel and Inconel as well as aluminum bronzes and beryllium copper.

There is also data on their new copper welding electrodes for welding copper and all copper alloys. A copy of this circular may be obtained by writing to Krembs & Co., 669 W. Ohio St., Chicago 10, Ill.

Worthington Announces New Magazine

Worthington Corp. has announced the first issue of the corporation's technical publication, Power and Fluids. The magazine will be presented quarterly and the editorial content will consist of information for readers in the power and fluid-handling fields, and will describe new product applications, processes, and methods. Subjects covered will include installations, operation, and maintenance of industrial apparatus and applications of particular interest because of specific problems involved.

The new publication will be distributed to Worthington customers and prospective customers, libraries, and industrial relations departments of recognized technical institutions including engineering colleges, technical societies, and industrial concerns requesting it. Reprints of articles appearing in Power and Flights will be furnished to the reader upon request.

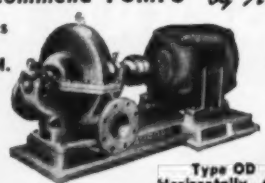
Diesel and Gasoline Engine Supercharger

How Miehle-Dexter Superchargers boost the power of Diesel and gasoline engines is the subject of a descriptive bulletin issued by the Miehle-Dexter Supercharger Div. of the Dexter Folder Co.

The four-page folder illustrates and describes the supercharger, and points out that the addition of a Miehle-Dexter supercharger to current or projected engine designs is said to be easy and often a less costly way to obtain additional power without increasing space requirements or engine weight. The bulletin also says that Miehle-Dexter units are often used as blowers on industrial applications requiring air or gases at moderate volume or pressures.

A table and graphs are included in the folder, to determine the proper size unit to be used on various applications. The folder is available by writing the Miehle-Dexter Supercharger Div., Dexter Folder Co., Racine, Wis., requesting Bulletin No. 153.

For the DEPENDABILITY You Seek
we recommend PUMPS "by Aurora"



Capacities to 4,000 G.P.M.
Heads to 300 Ft.
PUMPS "by Aurora"
For Every Purpose
Type OD Horizontally Split Case, Double Suction, Single Stage Centrifugal Pump
WRITE for BULLETIN 105
The Type OD PUMPS — for general water supply for municipalities, industries, office buildings, institutions — also — for handling liquids, chemical solutions, oils, etc. in industry.
APCO TURBINE-TYPE PUMPS — ideal for "1001" duties where small capacities and high heads predominate. Get acquainted.
Write for CONDENSED CATALOG "M"

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AURORA Always PUMPS
AURORA PUMP COMPANY
SUBSIDIARY OF THE NEW YORK AIR BRAKE COMPANY
96 LOUCKS STREET, AURORA, ILLINOIS

ONE BANNER
under which all may serve

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Motors and Generators

A consolidated catalog has been published by the General Dynamics Corp.'s Electro Dynamics Motor-Generator Div.

Detailed information on performance, dimensional data, construction advantages, installation photographs, and company history have been summarized in 12 pages as a guide for designers, maintenance men, and purchasing agents.

Product application information is presented in charts to aid in the selection of motors for ordinary applications of polyphase squirrel-cage induction motors. A page is devoted to electrical and mechanical modifications that are available for particular installation needs. Copies are available from General Dynamics Corp., Electro Dynamics Div., Ave. A and North St., Bayonne, N. J.

Computers, Recorders, and Equipment

Librascope, Inc., has published a series of leaflets on some of its products. The X-Y Plotter and Recorder is described in a four-page bulletin as a two-coordinate recording instrument for continuous-curve recording or discrete-point plotting. Inputs can be handled from decimal keyboard, punched cards, digital computers, or a variety of analog inputs including polar coordinates.

Librascope's Operational Recorder, a multiple-recording instrument for process timing, is covered in one of the leaflets. Components for which literature is offered are: a square-root planimeter for miniature strip chart recorders; a sine-cosine mechanism, to convert angular rotational movements into linear sine or cosine movements; a ball-and-disk integrator, for totalizing, rate determination, and differential analyzing; and a hollow-shaft differential.

Copies of this literature will be sent on request by Librascope, Inc., 1607 Flower St., Glendale, Cal.

Aluminum Strip

Scovill Mfg. Co., Waterbury, Conn., has issued a 20-page booklet covering the company's 64 years' work in aluminum since 1889, and its Truspec aluminum strip. The booklet received its initial distribution at the National Metal Exposition, which opened in Cleveland, Ohio, Oct. 19.

The booklet has been issued to announce the results of the latest research efforts by Scovill, which states it has "a new industry standard in controlled quality and uniformity" in its cold-rolled aluminum strip. This is achieved by exceptionally close control of inherent physical and mechanical properties of the metal, making it possible to minimize "orange-peel" and "earing" effects, according to the booklet.

Scovill has put into operation a new cold-rolling mill which uniformly produces aluminum coils weighing up to 2000 lb each, also giving fabricators the advantage of greater economy for very long runs.

A special section of the booklet contains technical data on five basic alloys offered currently by Scovill, including fabricating characteristics; standard temper designations; relationships between diameters, weights, lengths, and thicknesses of coils; gage comparisons; conversion factors; and definitions.

Screw Thread Inserts

Heli-Coil Corp. has announced the availability of the current issue of Heli-Call, the company's bi-monthly publication. The two-color, four-page publication, devoted to new techniques in thread engineering, tells how industry is using stainless steel wire thread inserts to provide superior threads in all materials.

Illustrated case-history examples in each issue show companies using these wire thread inserts in design, production, salvage, and maintenance. Copies of Heli-Call are available without charge from Heli-Coil Corp., 1389 Shelter Rock Lane, Danbury, Conn.

Heating Calculator

Paul S. Morton Engineering Service has announced the availability of a slide-rule heating calculator, "Morton's Btu Calculator." The device is 3 × 9 in. in size and is made of vinyl plastic.

To use the Calculator, either the area or the volume is set in the window, and on the same line under the desired glass, infiltration, or U factor the number of Btu can be read directly.

Five different scales appear along the edges of the Calculator, which also has a table of the more commonly used heat-loss U factors. Morton's Btu Calculator complete with plain leatherette case can be obtained from Paul S. Morton Engineering Service, 609 Bangor Rd., Lawrence, Mich., for $3.75 postpaid.

Front-End Loader

Specifications for the Baker-Lull 4B Front-End Loader mounted on various models of R. H. Sheppard Industrial-type Tractors are shown in a two-color catalog sheet available from Baker-Lull Corp., Minneapolis, Minn.

The literature covers the R. H. Sheppard SDL-1, -2, and -3 series and lists materials handling tools available with the Shoveloader. A description of the Sheppard fuel injection system is also included. Requests should be directed to Dept. KP, Baker-Lull Corp., 376 W. 90th St., Minneapolis 11, Minn., for Form No. A5202-1.

Rotary Compressor Installation

A reprint of a technical article, offered by the Fuller Co., Catasauqua, Pa., pictures and describes a six-unit rotary compressor installation that supplies compressed air for three different plants. This installation is part of a centrally located power plant that supplies, in addition to compressed air, steam and other utilities to neighboring plants.

The reprint describes the two-stage rotary compressors and covers operating sequence in detail. Included is a description of the process for dehumidifying compressed air.

Photos show the compressor installation, receivers located in the power plant basement, and twin desiccant towers. For copies of this reprint write to Fuller Co., Catasauqua, Pa.

"TIMBER-R-R"
WISCONSIN-POWERED
Generator *Supplies Current*

Quick falls for the big ones, such as this 6½ ft. Douglas fir, are easy when this Electric Chain Saw goes to work. Furnishing the 180 cycle, 3 phase, 220 volt current is an electric generator, powered by a Model VF-4, V-type, 4-cylinder Wisconsin Heavy-Duty Air-Cooled Engine.

In the timber country and in many other fields, Wisconsin Engines are *preferred power* for these reasons:

Tapered roller bearings at both ends of the crankshaft eliminate all thrusts • Foolproof AIR-COOLING, summer and winter • An easily-serviced, high-tension outside magneto with impulse coupling for quickest all-weather starts • Rugged construction for heavy-duty service.

Today, write for the new 64-page application and specification booklet, covering all 4-cycle single-cylinder, 2-cylinder and V-type 4-cylinder models, 3 to 36 hp.

Power TO FIT THE MACHINE

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Permanent Magnets

Latest information on the uses, design, properties and manufacture of Alnico permanent magnets, cast grade 7, is available in the four-page technical report PM-112, issued by Carboloy Dept. of General Electric Co., Detroit 32, Mich.

In addition to graphs and tables explaining magnetic and physical characteristics of the magnets, the report includes a detailed discussion of design considerations, test information, and a general comparison of cast grade 7 with other magnetic materials.

Lubricating Electric Motors

Comparisons of methods for lubricating electric motors are shown in a Bulletin 1848 issued by US Electrical Motors, Inc. The bulletin illustrates three principal types of bearings used in motors—cartridge, standard open, and Lubriflush types—with explanations of the function of each. To demonstrate the action of re-lubrication in the US Lubriflush bearings, a series of color photos are reproduced of a transparent bearing housing. Proof that any motor bearing breathes air and therefore leads to contamination of the bearing is demonstrated photographically, to indicate the necessity of lubrication. Excerpts of statements by bearing manufacturers about the necessity of motor lubrication are presented. A copy of this bulletin featuring Lubriflush will be sent by US Electrical Motors, Inc., Box 2058 Los Angeles 54, Cal.

High-Frequency Pressure Cells

Utilization and specifications of new SR-4 high-frequency pressure cells, Type "HF," in the measurement of rapidly changing pressures up to 20,000 psi are presented in an illustrated bulletin No. 4107, by Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa. It is available on request.

Line-Type Purifiers

A new separator catalog, Condensed Bulletin No. 201, describes Anderson's Line-Type Hi-eF Purifiers and their many uses throughout industry. The folder discusses the removal of entrained moisture and scale in steam to turbines, reciprocating engines, and regulating valves; oil, dirt, condensate, etc. from exhaust steam; condensate from compressed air lines; dirt particles and line scale from steam in food processing operations; and entrainmen. and carryover from vapor lines following evaporation.

In this catalog the selection of purifiers has been simplified by charts which enables the user to select the size Hi-eF Purifier that will give the best efficiency at various flows and pressures. Other features of the catalog include installation diagrams, tables of dimensions and weights, and other buying information.

For a complimentary copy write to Purifier Div., The V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

Press Control Switches

Catalog No. 59 of the Micro Switch Div. of Minneapolis-Honeywell describes the line of Microtrip Electric clutch controls for power machines. Description of auxiliaries and accessories is given, including clutch-actuating equipment.

A table of equipment required for desired combinations of one or more operators, using two or more hands or one foot, is in the catalog, which is obtainable by writing Micro Switch Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill.

Propeller Fan

Three new models are among the thirteen types of fans shown in the Hartzell Propeller Fan Co.'s Bulletin A-109. The additions to the Hartzell line are a panel fan, a high-pressure fan, and a direct-drive Lo-Noise fan. The bulletin also describes three types of roof ventilators, unit heaters, and intake air units.

The illustrated 40-page book includes specifications, dimensions, and performance figures on all of the equipment, plus engineering data. A special feature is a discussion of corrosion-resistant materials and coatings which includes a table showing the suitability of special materials and coatings for use in a variety of fumes commonly encountered in industrial installations.

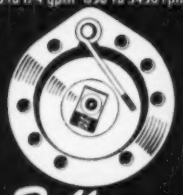
Copies of the new book, Bulletin A-109, may be secured by writing to the Hartzell Propeller Fan Co., Piqua, Ohio.

Are you pumping $$ into wrong pump sizes?

Pioneer IMPELLER TYPE PUMPS
0 to 174 gpm 850 to 3450 rpm

Over 400 models of standard PIONEER and ROLLWAY pumps to choose from. Thus you can be sure of exactly the right pump for your job . . . capacity-tested at the factory. No need to pay extra for capacities not needed.

To save on pump costs, power costs, maintenance costs, installation costs and space, ask for complete Manual and Catalog #43.



Rollway POSITIVE DISPLACEMENT LUBRICANT PUMPS
1 pt. to 60 gpm 200 to 500 rpm

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DETROIT HARVESTER Co
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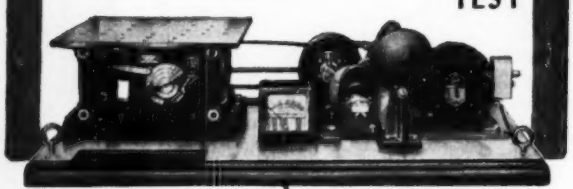
Give Parts, Assemblies a Positive VIBRATION TEST



ALL AMERICAN VIBRATION FATIGUE TESTING MACHINE

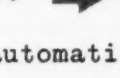
Model 100 HL-A
Capacity 100 lbs. Produces vibrations horizontally. New 4-point linkage arm table support.

NATIONAL Bureau of Standards uses four, Mass. Inst. of Technology two, Western Electric 13, Westinghouse and G. E. 12 each. Basic equipment for YOUR testing laboratory or inspection department. In many plants a laboratory in itself. Detect excess weight—find structural weak spots.

For electronic, automatic, aircraft, crystal, optical and instrument makers, schools and research laboratories. Models to test parts from a few ounces to 100 lbs. Choice of horizontal or vertical table movement. Frequencies of 600 to 3600 v. p. m. Automatically or manually controlled. Send for Catalog F.

ALL AMERICAN Tool & Manufacturing Co.

8019 LAWNDALE AVE. • SKOKIE, ILL.

Take the low rolling friction of a ball add the greater load-carrying capacity of a roller and see the basic advantages offered you in a Shafer CONCAVEX Bearing. In a Shafer Bearing the inner race is a segment of a true sphere and rollers are concave Normal loads are carried on more than half of the center area contact Under heavy loads case-hardened races and rollers compress increasing load area and bearing surface. This CONCAVEX principle provides exceptionally high reserve to handle shock loads and severe vibration How about thrust loads? In the CONCAVEX Bearing these loads are also taken in the center area and not at the roller ends as in the average roller bearing. Thus you have the right combination to handle Thrust  Radial or Angular or all Add automatic self-alignment positive "Z" seals, Micro-Lock adjustment that compensates for wear, and you'll see why all industry looks for SHAFER on Pillow Blocks Flange Units Cartridge Units Flange Cartridge Units Take-up Units Duplex Units Take-up and Frame Units and Self-Contained Bearings Call or write Shafer Bearing Division of Chain Belt Company, 801 Burlington Ave., Downers Grove, Illinois.

leading Bearing Design for more than 33 years!

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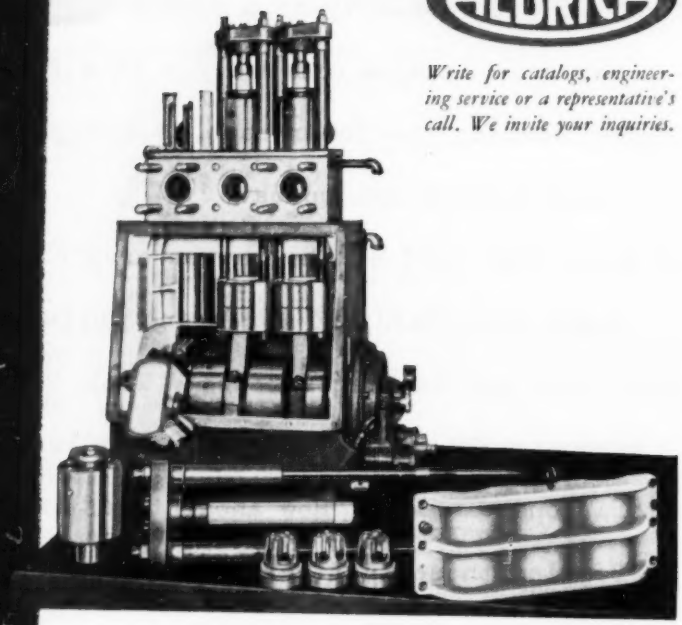
CHAIN BELT COMPANY

Why ALDRICH PUMPS Reduce Maintenance Cost



ALDRICH

Write for catalogs, engineering service or a representative's call. We invite your inquiries.

Design simplicity . . . rugged construction

Aldrich Pumps are built to take punishing service year after year. You can find Aldrich Pumps, today, in good running order after 30, 40 and even 50 years of service. Durability such as this is the result of Aldrich's design simplicity and rugged construction.

Accessibility . . . sectionalization

When wearing parts are due for replacement, in Aldrich Pumps they can be replaced easily, quickly and at low cost. For instance, manifolds can be moved out on the holding studs and you can lift out and replace valves as complete units. . . . Stuffing boxes are particularly accessible—making it easy to renew packing. . . . To meet a change in pressure or capacity requirements, plunger sizes can be changed — in most cases merely by using new glands, throat bushings and packing in the same fluid-end. . . . Wearing parts are interchangeable among pumps of the same stroke size. . . . Fluid-ends are sectionalized to make possible low cost parts replacement and can be made of stainless steel, bronze, Monel or other material.

Aldrich Pumps Are Used for Hydraulic Systems Involving Operations Such As:

Forging	Stamping
Extrusion	Die Casting
Molding	Descaling

Roll Balancing

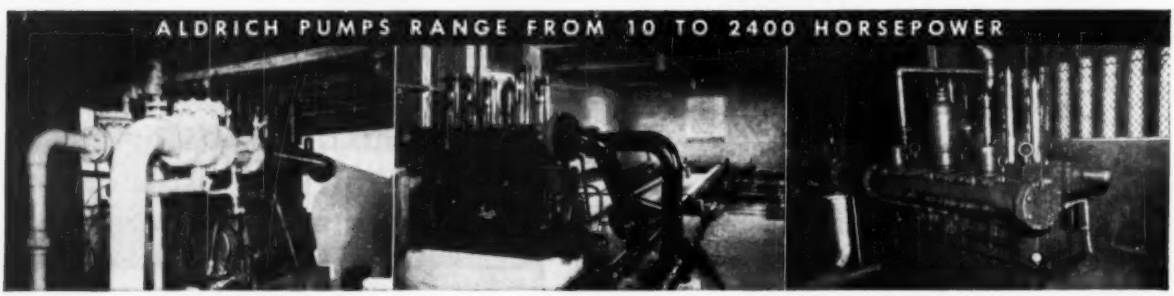
Water as Hydraulic Medium Cuts Fire Risk

With Aldrich Pumps *water*—as well as oil—can be used as hydraulic medium. With water, you can eliminate chances of plant damage or injuries due to oil fire . . . and you can reduce hydraulic fluid costs.

Representatives in Principal Cities

The Aldrich Pump Company

29 Pine Street • Allentown • Pennsylvania

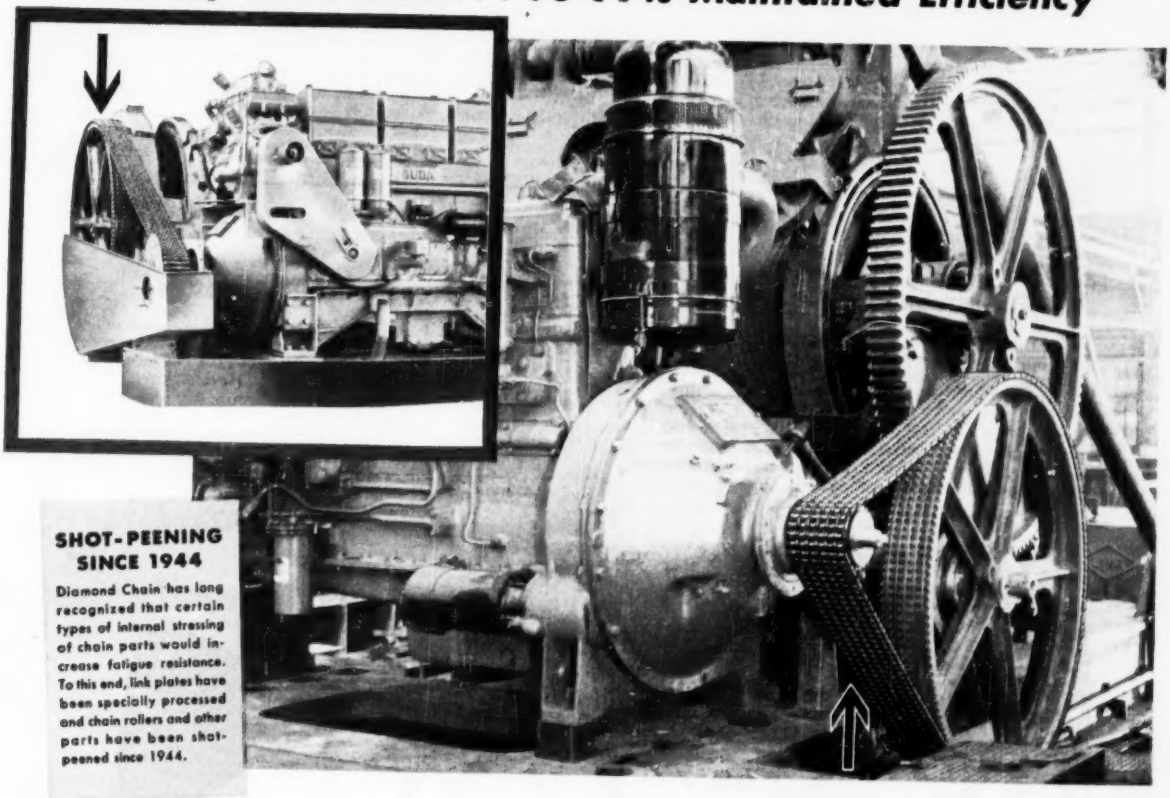


They have the Stamina for Power Take-Off Drives

Diamond Roller Chains

Provide Long-Life Dependable Performance . . .

No Slip or Stretch . . . 98-99% Maintained Efficiency



SHOT-PEENING SINCE 1944

Diamond Chain has long recognized that certain types of internal stressing of chain parts would increase fatigue resistance. To this end, link plates have been specially processed and chain rollers and other parts have been shot-peened since 1944.

• Diamond Roller Chains cut maintenance and adjustment costs. The toughened side plates of great reserve strength take the shock loads and tension;—the hardened finished surfaces of the rollers, bushings and pins resist wear for longer useful life. At high, medium or slow speeds, operation is smooth and quiet with exact speed ratio maintained.

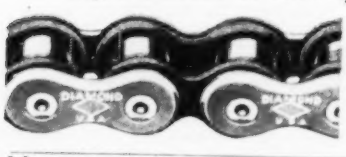
DIAMOND CHAIN COMPANY, Inc.

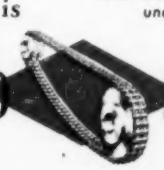
Where High Quality is Traditional

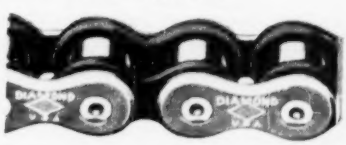
Dept. 413 402 Kentucky Ave., Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities

Refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER



DIAMOND  **ROLLER CHAINS**



4 reasons why Trane dry-type fluid coolers last longer

1 Correct metal selection

A wide variety of types of metals are available for highly corrosive applications. Coils can be supplied in combinations of cupro nickel, admiralty, red brass, copper, aluminum, monel, steel, stainless steel and many other special metals. TRANE engineered products have solved corrosion problems of all types, yet obtained maximum heat transfer and maximum life from the fluid circuit.

2 Permanently bonded fins

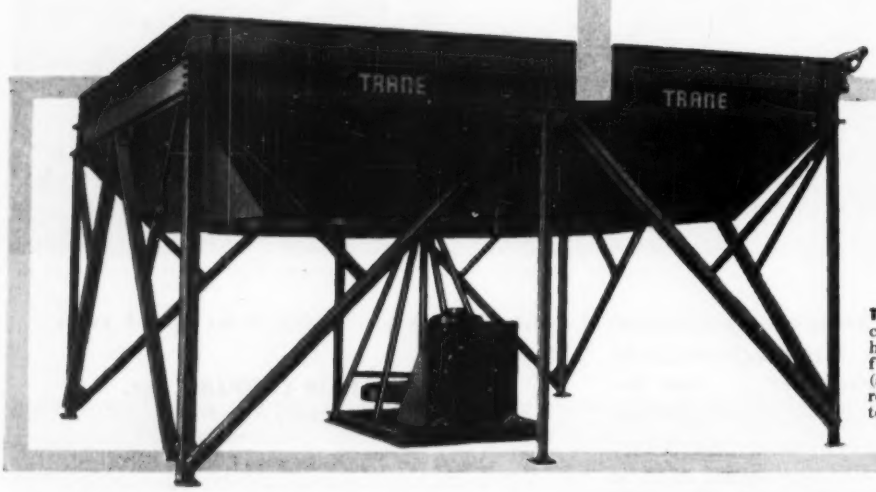
In constructing the Extended Surface Coil—heart of the fluid cooler—TRANE bonds fin to tube *mechanically*. This bond is as permanent as the metals that form it and as strong as though fin-and-tube were one. Heavy support plates are used to reinforce and protect the coil and prevent tube sagging. And the exclusive TRANE Guide Flange cradles the coil to permit expansion within casing.

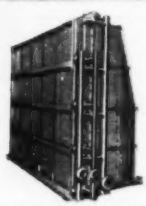
3 Extra-rugged construction

Framework of the TRANE Fluid Cooler is so strong it can be used for stationary or portable installation *without additional bracing*. Its simple structural design permits fastest possible erection. Yet it is more than strong enough to support core and accessories and withstand wind and shock load. Finish on the TRANE Fluid Cooler is a rubber-base paint that's completely weatherproof.

4 Freedom from vibration

TRANE Fluid Coolers run smoothly . . . quietly. They stay sound and tight longer because TRANE engineers have virtually eliminated the causes of vibration. Here's how: The variable-pitch fans are dynamically balanced. Solid, oversized fan shaft is firmly mounted in giant thrust bearings. Drive components are aligned at the factory and shipped assembled. Orifice ring is designed to *match* the fan.





Trane Dry-Type Fluid Coolers can be used profitably in hundreds of ways. Series GC for vertical discharge (shown above) is made in 6 regular sizes with fan diameters ranging from 72" to 144".

Jacket water cooling costs are cut to the minimum with the TRANE horizontal air stream Fluid Cooler. Series EC—available in 14 sizes with fan diameters from 18" to 120".

TRANE *pioneers in the science of heat exchange*

The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn.
Trane Co. of Canada, Ltd., Toronto • 80 U.S. and 14 Canadian Offices

MANUFACTURING ENGINEERS OF HEATING, VENTILATING, AIR CONDITIONING AND HEAT TRANSFER EQUIPMENT

B SERIES • Light duty, one direction ball thrust bearing. Flat seat. Flat races. Bronze ball retainer . . . 38 sizes ½" to 3½" I.D.

C SERIES • Light duty, one direction ball thrust bearing. Flat seat. Flat races. Pressed steel retainer . . . 16 sizes ½" to 1¾" I.D.

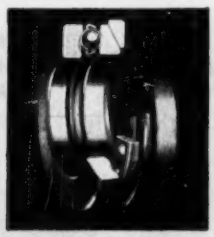
F SERIES • Light duty, one direction thrust bearing. Flat seat. Grooved races. Pressed steel retainer . . . 43 sizes ½" to 3½" I.D.

G SERIES • Medium duty ball thrust bearing. Grooved races. Pressed steel or bronze (large sizes) retainer . . . 76 sizes ½" to 7¾" I.D.

E SERIES • Medium duty ball thrust bearing. Banded. Flat seat. Grooved races. Full complement of balls . . . 40 sizes ½" to 3½" I.D.

1000 SERIES • Light duty ball thrust bearing. Flat seat. Grooved races. Pressed steel retainer. Metric standard . . . 26 sizes 10 to 125 mm. I.D.

1100 SERIES • Medium duty ball thrust bearing. Grooved races. Pressed steel or bronze (large sizes) retainer . . . 23 metric sizes 10 to 140 mm. I.D.



1400 SERIES • Medium duty. Grooved races. Spherical seat. Pressed steel or bronze (large sizes) retainer . . . 23 metric sizes 10 to 140 mm. I.D.

W SERIES • Case hardened and ground flat washers for various Thrust and Spacer applications. Slip fit. 38 sizes ½" to 3½" I.D.

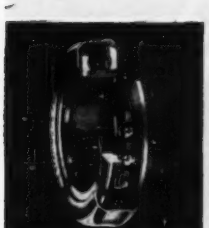
R SERIES • Ball thrust retainer. One piece, pressed steel, channel type cage . . . 79 inch sizes 0.266" to 4.232" I.D.

Just Name Your Need

Whatever mechanized equipment you make or use—whether it is large, small, rugged, fragile, heavy or light—whether it must operate at high speed, low speed, under water, in acid or under extreme temperature or dust conditions, it will do its job better, more efficiently and more economically if bearing equipped. If it is equipment that lends itself to bearing applications of the thrust type—Aetna has the answer or can come up with it pronto. 37 years of thrust bearing know-how assures this. Inquiries invited. No obligation. Aetna Ball and Roller Bearing Company, 4600 Schubert Ave., Chicago 39, Illinois.

Aetna

Precision Bearings and Parts for Every Branch of Industry



CLUTCH BEARINGS • Ball thrust clutch release bearing. Banded. Pre-lubricated. T-type, all impregnated bronze retainer assures concentricity and smooth, quiet, long-life performance.

SPECIAL BEARINGS • Facilities for sizes up to 38" O.D. Counsel that brings you the expert technical aid that has licked many of industry's toughest bearing application problems.

PRECISION PARTS • Aetna is versatile—can mass-produce vital parts in almost limitless sizes and shapes—to your most exacting metallurgical, tolerance and finish specifications.

Write **for latest catalog. Contains specifications on Aetna's complete line—vital technical reference data on bearing selection, load capacities, lubrication, care and maintenance.**

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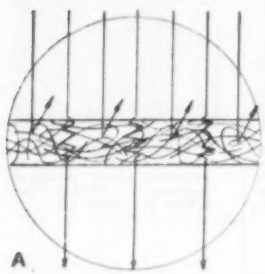
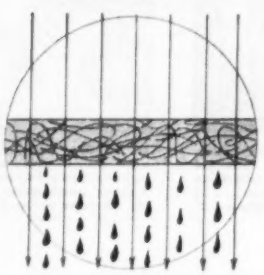
How tracing paper is made and why ALBANENE* is Different

TOUGH, LONG-FIBER PAPER
NOT TRANSPARENTIZED



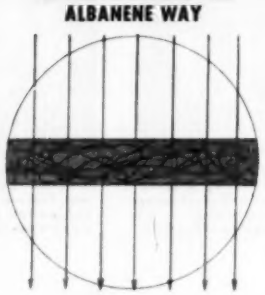
Diagrammatic enlargement of cross section of paper with high strength but low transparency. Fibers are surrounded by air, which has different index of refraction. Many light rays are bent back and do not get through.

SAME PAPER
TRANSPARENTIZED WITH FLUID MATERIAL



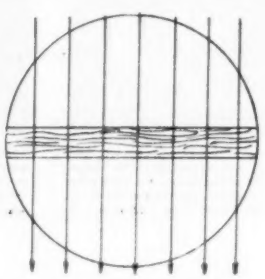
Same paper as "A", filled with oil or other fluid material, giving spaces between fibers same index of refraction as fibers. Reflection and refraction of light are reduced and paper becomes highly transparent. But transparency is not permanent because *fluids* "bleed" out.†

SAME PAPER
TRANSPARENTIZED THE ALBANENE WAY



Same paper as "A", filled with an inert synthetic resin, with correct index of refraction. This is how Albanene is made. Its transparentizer does not "bleed" out. Albanene holds its color and strength and is permanently transparent.†

PAPER TRANSPARENTIZED BY
CRUSHING AND BEATING FIBERS



Papers are also transparentized at the mill by a "beating" process. The fibers are crushed, flattened and compacted. Reflection and refraction of light are reduced. But the process weakens the fibers and the strength of the transparent paper is low.

More than 15 tests are made during production of Albanene. For example, each production roll is tested for pencil "take", for pencil erasing and the taking of drawing ink. To eliminate human variables, pencil lines are drawn by machine. In this way you are assured of the uniformity of working surface so much desired by draftsmen, and assured of a paper that makes cleaner, sharper prints . . . now or a generation later. Ask your K&E Distributor or Branch for further information.

† Prove this by making the "drafting tape test" Press a short piece of drafting tape on fluid-transparentized paper, and another on Albanene. Strip them off the next day and examine both papers. Notice that enough fluid has drifted out of the ordinary paper into the tape to destroy much of the transparency. And notice that Albanene is not affected. What drafting tape does over night, time will do naturally.

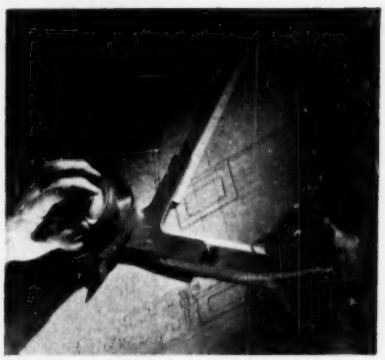
*TRADE MARKS ®

Transparent... and Better!

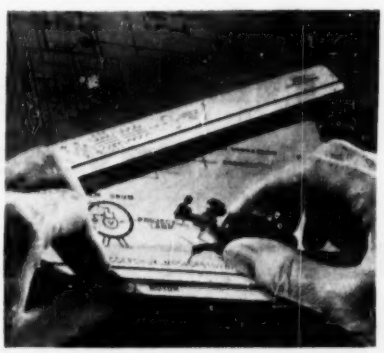
The Right Angle

AVAILABLE IN MANY FORMS FOR MANY USES

Albanene comes in 20-yard and 50-yard rolls in various widths and in three different weights. For those who like the convenience of cut sheets, a new Albanene package has been designed. It strongly protects the paper in shipment and storage, and may be opened without mutilating the container, thus serves as a dispenser in drafting room or stock room. Albanene cut sheets can be supplied imprinted to your specifications.



Once you've discovered the pleasure of drawing on Albanene, the next logical step is to save time, trouble and eyesight with a K&E PARAGON* Drafting Machine. You control your calibrated straight edge with a light touch of one hand, for parallel lines and lines at any angle.



Make your lettering letter-perfect and save wear and tear on your nerves by using a LEROY* lettering outfit. Template grooves guide your pen so the finished result looks like printers' type, and the whole process is relaxing. There's a wide choice of sizes, styles and symbols.

K+E

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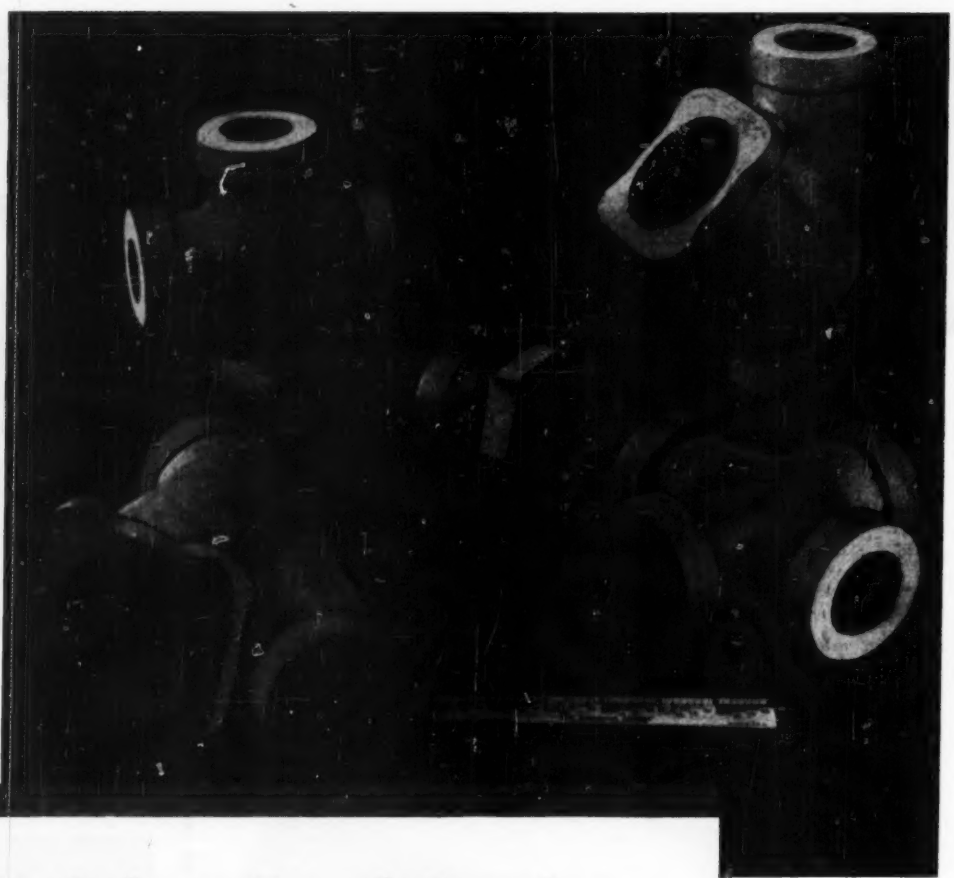


AL Stainless Steel Castings meet any need for Cleanliness

Here's New Data on

ALLEGHENY METAL

in Various Industries

Available *now*—informative booklets on Allegheny Metal in the Chemical, Petroleum Refining, Brewing, Meat Packing, Dairy, Food Processing, Hospital and Laundry Industries—others in preparation. Write for this valuable data on the field in which you are interested.

ADDRESS DEPT. ME-48

Note the clean, sound, fine-grained appearance of the Allegheny Metal sanitary fittings shown above, in the "as-cast" condition. They're typical of the wide variety of stainless steel castings we produce for the chemical processing, food, dairy, beverage, oil, paper and textile industries, etc.—wherever the purity and quality of products must be maintained, and where ease of sanitation and assurance of long, trouble-free service are prime considerations.

Allegheny Metal castings are produced by methods specially developed to protect uniform quality and guard against defects. You'll find them superior both from the standpoint of machinability and soundness. ● Let us quote on your stainless casting requirements—any shape and any size, from a few ounces to 5000 pounds. *Allegheny Ludlum Steel Corporation, Henry W. Oliver Bldg., Pittsburgh 22, Pa.*

You can make it **BETTER** with

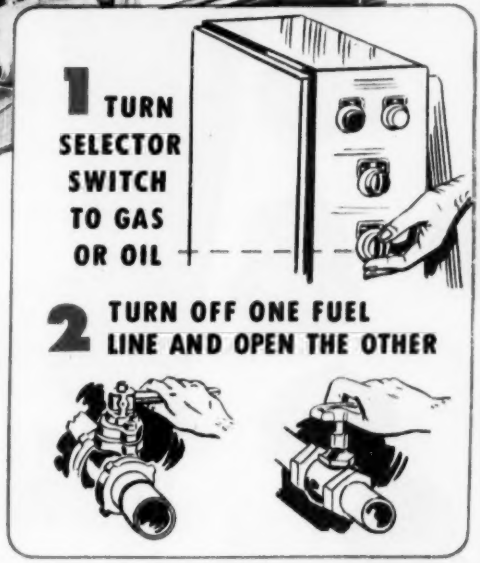
Allegheny Metal

WAD 4440

AL® TIME-TESTED STAINLESS STEEL

NOW... interchange Gas and Oil firing in *10 seconds*

Modern Cleaver-Brooks Model LR Steam Boiler Equipped with Exclusive Cleaver-Brooks "10-second conversion" Combination GAS and/or OIL Burner



TWO, simple motions eliminate time-consuming change-over

Now you can use oil or gas at the flick of a switch! This exclusive new Cleaver-Brooks development permits changeover from oil to gas or vice versa in only 10 seconds.

That's because the Cleaver-Brooks Combination Gas and/or Oil Fired Boiler operates on gas *with the oil burner in place*. Simply flipping a selector switch on the control panel to either gas *or* oil sets the proper circuit in action. Turning the convenient fuel supply valves completes the entire changeover — and in 10 seconds or less!

To gas users in all parts of the country — and in particular areas where local requirements demand immediate changeover — this exceptional fuel flexibility can be an important factor in determining your overall operating economy.

Ten-second conversion, like 4-pass construction, self-contained design,. guaranteed 80% efficiency when firing with oil, is another "plus" feature pioneered by Cleaver-Brooks. It demonstrates Cleaver-Brooks' continuing effort to bring steam users even greater flexibility and reduced operating costs.

Consider Cleaver-Brooks boilers for simplifying your operation. Automatic firing on oil, gas or combination oil/gas fuels, plus extra conveniences, assure greatest investment return. Write for catalog.

Cleaver-Brooks

Originators of the Self-Contained Boiler

CLEAVER-BROOKS COMPANY
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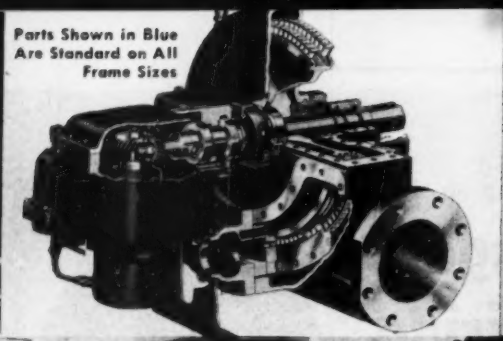
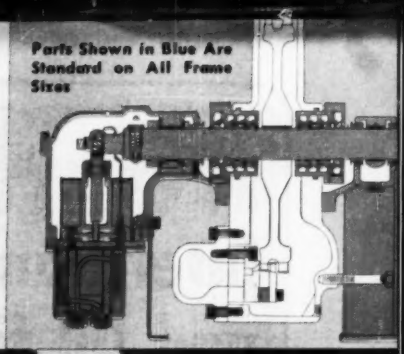
Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

BOILERS — STEAM OR HOT WATER — FOR HEATING AND PROCESSING, IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI





This display of interchangeable parts on G.E.'s Type DP turbine covers over 85% of the parts subject to wear—means you tie up less money in inventory.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

85% Interchangeability of Turbine Parts Means Less Money Tied Up in Inventory

Over 85% of the wearing parts are interchangeable among General Electric's Type DP Turbines—regardless of turbine rating. This means you don't have to tie up a lot of money stocking spare parts for each turbine; one set of parts protects a whole line-up. This feature alone can save you up to $100.00, even in installations of just two turbines of different sizes. Greater savings, of course, accrue as the number of turbines in the plant increases.

All of the parts, except for the governing end, are also interchangeable between G.E.'s Type DP Mechanical-drive Turbine and the Type DR which is designed for slightly wider speed range and greater horsepower.

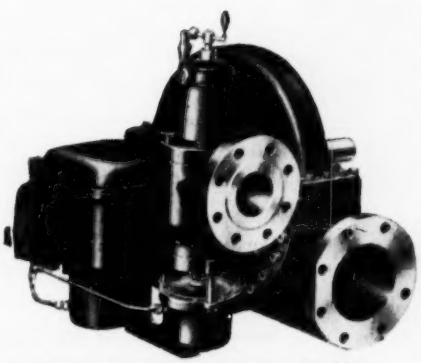
This interchangeability is just one of many DP features which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features that save you extra costs. For more information contact your nearest G-E Apparatus Sales Office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 252-65

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00

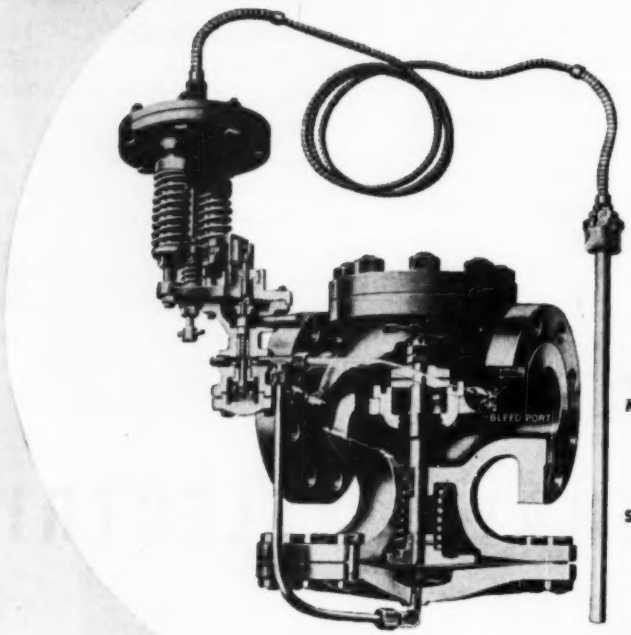


G-E Type DP Mechanical-drive Turbine

COMPARE THE FEATURES
EVALUATE ALL THE COSTS

See why G-E Standard Type DP turbines are your most economical buy.

3 Reasons for Accurate Regulation



PACKLESS CONSTRUCTION

LARGE BALANCED METAL DIAPHRAGM

SENSITIVE PILOT

Spence

Packless construction eliminates the need for closely fitted parts that may stick or bind due to dirt or uneven expansion of the parts.

In Spence Temperature Regulators, the Main Valve is actuated by a large balanced metal diaphragm which responds to the slightest changes in temperature.

Sensitive Pilots are designed to limit heater pressure to an adjustable maximum. As the temperature at the thermostat drops a few degrees there is a corresponding increase in steam pressure up to the limit for which the Pilot is set.

With regulators that respond only to temperature, an increase in load is accompanied by a momentary decrease in steam pressure caused by faster condensation in the heating element. There is a time lag until the thermostat senses the temperature drop and opens the valve wider. Spence Temperature Regulators act like pilot operated pressure regulators when this occurs. They respond instantly to maintain the steam pressure until the thermostat has a chance to further increase it as needed for the heavier load.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year, without requiring extensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.

SE128

SPENCE ENGINEERING COMPANY, INC., Walden, New York

These Kodagraph Autopositive Intermediates

Protect vital drawings

You're looking behind the scenes at the American Locomotive Company, Ordnance Division, Schenectady, New York.

The prints you see streaming from the processing machine are positive photographic reproductions of M47 tank drawings. They're produced without a negative step . . . and under ordinary room light.

This fast, low-cost operation enables the Ordnance Division to protect thousands of M47 drawings against expensive wear and tear. For the drawings are filed away after the Autopositives are made. Then, because the engineering department of the Ordnance Division holds the design contract for the M47, these highly legible and durable intermediates are used to produce all the quantity prints required by the 29 manufacturers and government agencies involved in the distribution of engineering changes on the M47 tank.

Produce better prints

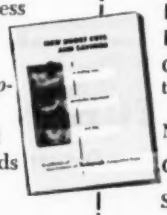
These Kodagraph Autopositive intermediates, used in place of the valuable original drawings, produce sharp, legible blueprints or direct-process prints time after time. Their dense photographic black lines—on an evenly translucent paper base—will not smear or lose density . . . which simplifies print production and eliminates reading errors and bottlenecks all along the line. *And another important point*—Autopositives are photo-lasting in the files . . . will not turn yellow or become brittle.

Advantages which you will appreciate, too, in your own operations. *And, remember, this is only part of the Autopositive story!*

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

Learn how you, or your local blueprinter, can process this unique photographic intermediate paper at low cost . . . *with existing equipment;* how it is used to reclaim drawings . . . speed design changes in thousands of drafting rooms.



MAIL COUPON TODAY

16

EASTMAN KODAK COMPANY
Industrial Photographic Division, Rochester 4, New York

Gentlemen: Please send me a copy of "New Short Cuts and Savings". . . describing the many savings Kodagraph Autopositive Paper is bringing to industry.

Name_____ Position_____

Company_____

Street_____

City_____ Zone_____ State_____

Kodak
TRADE-MARK

How would YOU solve these two problems?

1. FLINTKOTE INSULATED SIDING is saturated with hot asphalt by a continuous conveyor process through a dip tank. Fenwal THERMOSWITCH® Thermostats, connected to pilot lights, warn when asphalt varies from safe operating level. The totally enclosed mechanism of the THERMOSWITCH units is not affected by the high heat (420°F) or viscosity of the liquid.

2. LABORATORY WORK SAVED. Let one Fenwal All-Purpose Laboratory THERMOSWITCH thermostat do the work of many. This unit has a quick-disconnect plug — goes readily from job to job. It provides close temperature control for solids, liquids and gases. Stainless steel shell, resistant to corrosion, shock and vibration.

3. YOU, TOO, MAY BENEFIT from a Fenwal THERMOSWITCH Control.* Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved many types of temperature control problems throughout industry. The external, single-metal shell expands or contracts *instantly* to temperature changes, making or breaking electrical contacts.

*Cartridge Type Illustrated

4. SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write **Fenwal Incorporated, 512 Pleasant St., Ashland, Massachusetts.**

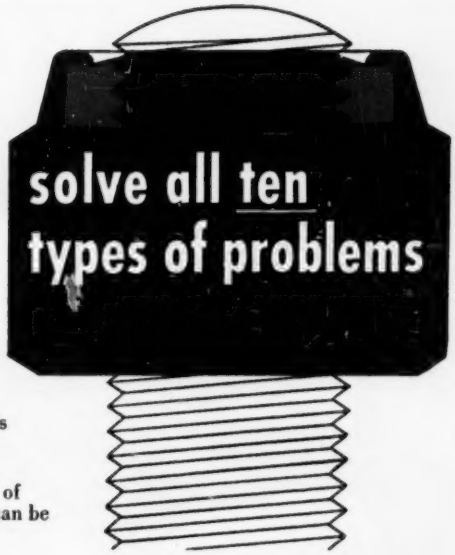
Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*

elastic stop nuts solve all ten types of problems

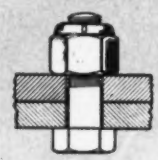


Here are ten typical fastening problems. One device, the ELASTIC STOP nut, solves them all—without additional parts or operations. Deliberately undersized in relation to bolt diameter, the red elastic collar grips the bolt with a perfect fit, exerting a continuing self-locking pressure against the threads, and holding the nut securely in place at any point on the bolt. It also provides a tight seal against the bolt threads, which prevents seepage and wear-producing axial play. And because the bolt threads are protected against moisture from without, the nuts are not "frozen" to the bolt by corrosion.

ELASTIC STOP nuts stay tight, right where you put them, in spite of vibration and stress reversals. Yet they are not jammed in place, and can be removed with a wrench and reused many times.

For further information on ESNA self-locking fasteners, mail the coupon below.

TIGHTENED AGAINST THE WORK

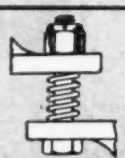


Wherever a vibration or impact proof bolted connection is desired.

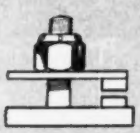
On all electrical terminals subjected to vibration in transit or operation.

For uniform and precise prestressing of multiple bolt assemblies . . . adjusted by predetermined wrench torques.

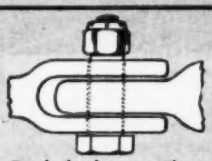
LOCATED ANYWHERE ON THE BOLT



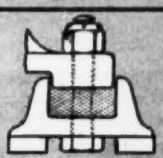
Spring-mounted connections or dynamic balancing, where nut must stay put yet be easily adjusted.



On make-and-break adjustment studs where accurate contact gaps are required.

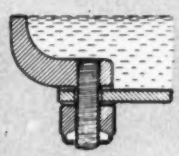


For bolted connections requiring predetermined play.



For rubber-insulated and cushion mountings where the nut must not work up or down.

FOR MANY SPECIAL APPLICATIONS



To seal bolt threads where elimination of leakage past stud threads is necessary.

To seal bolt threads where it is necessary to protect them from corroding elements.

To obtain delicate adjustments for applications such as bearing locknuts where precise adjustment is essential.

ELASTIC STOP NUT CORPORATION OF AMERICA

Dept. N40-1211 Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, New Jersey

Please send the following free fastening information

☐ Elastic Stop nut bulletin ☐ Here is a drawing of our product. What self-locking fastener would you suggest?
☐ Rollpin bulletin

Name _____ Title _____

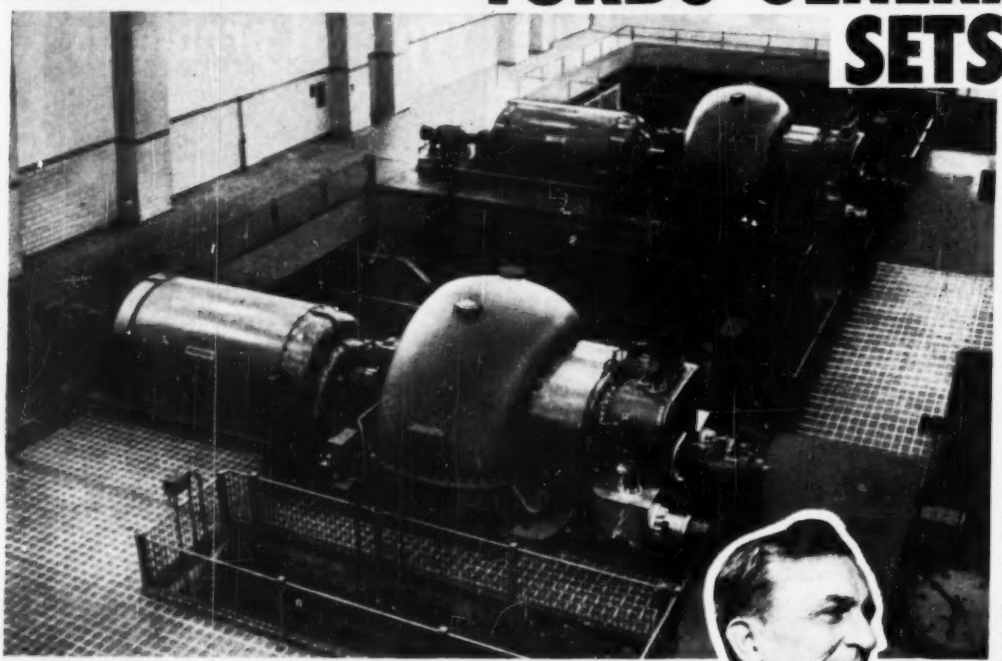
Firm _____

Street _____

City _____ Zone _____ State _____

BROWN BOVERI

TURBO-GENERATOR SETS . . .



View in the Cleveland Municipal Power Plant with its new Brown Boveri 25,000/32,500 kW turbo-generator sets. The City of Cleveland saved enough on the two units to purchase a third generator if so desired. These units were produced and delivered as scheduled.

"They saved the City of Cleveland over $500,000 in initial cost alone."

says

EMIL J. CROWN
Director of Public Utilities
City of Cleveland
Cleveland, Ohio

"We have every reason to believe that the two Brown Boveri turbo-generator sets now installed in the City of Cleveland power plant, will meet our every expectation. They saved the City of Cleveland over $500,000 in initial cost alone."

INITIAL economy is not the only factor involved in the selection of Brown Boveri power generating equipment. The proven quality and operating economics of these turbo-generators — evidenced by the consistently dependable, year-after-year performance of similar Brown Boveri equipment — are equally major considerations.

It will pay you to investigate Brown Boveri turbo-generator sets. Write for complete data.

BROWN BOVERI

BROWN BOVERI CORPORATION
19 Rector St., New York 6, N. Y.

Money-Savers

Only Midwest "Long-Tangent" Elbows have these longer tangents (dotted lines indicate their length beyond ends of ASA Elbows). Tangents are ¼ of nominal diameter: a 12" elbow has tangents 3" long.

This young man's dad also saves money. But he does it by specifying Midwest LONG-TANGENT Elbows whenever he needs welded piping. These elbows (see above) can be lined up with pipe more quickly and accurately. Less pipe is required and a short nipple (with its extra circumferential weld) is frequently eliminated. Slip-on welding flanges are easily used with minimum change in either flange or fitting. And then . . . Midwest "Long-Tangent" Elbows cost no more than ASA Elbows. You, too, can save money by specifying them on your next welding fittings order.

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

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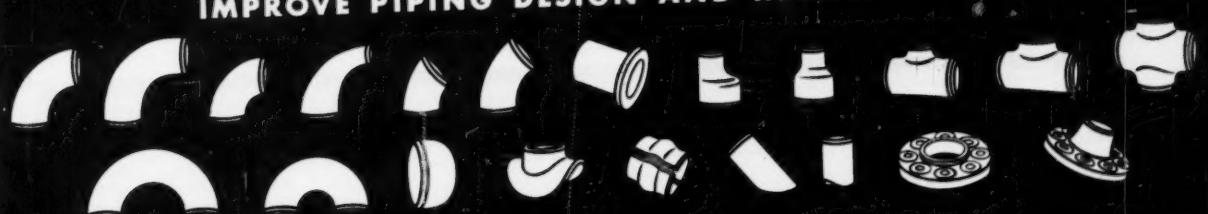
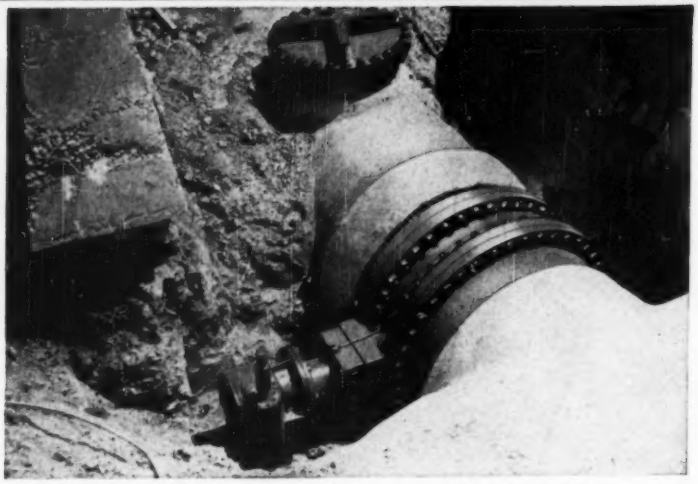
MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN AND REDUCE COSTS



R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



Simplified Control and Shut-off of Volume and Pressure

The underground application shows a 50-pound R-S Valve with gear reducer, lubricating lines and operating nut which is hand operated with a wrench. Only a few turns of the wrench are required to open or close the valve.

Practically every R-S Valve installation, particularly when automatically controlled, provides useful experience that can be applied in other industries although they may be far apart in classification. It is this accumulation of engineering experience coupled with unexcelled production facilities that can be so helpful to you.

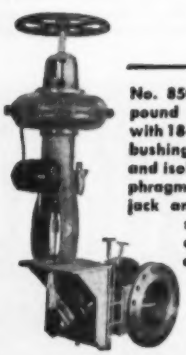
Call the R-S representative at the inception of your application. Benefit by his research and engineering experience in the simplified control and shut-off of volume and pressure.

S. MORGAN SMITH Company • YORK, PA.

MANUFACTURERS OF

HYDRAULIC TURBINES - VALVES

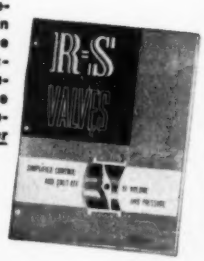
REPRESENTATIVES IN PRINCIPAL CITIES

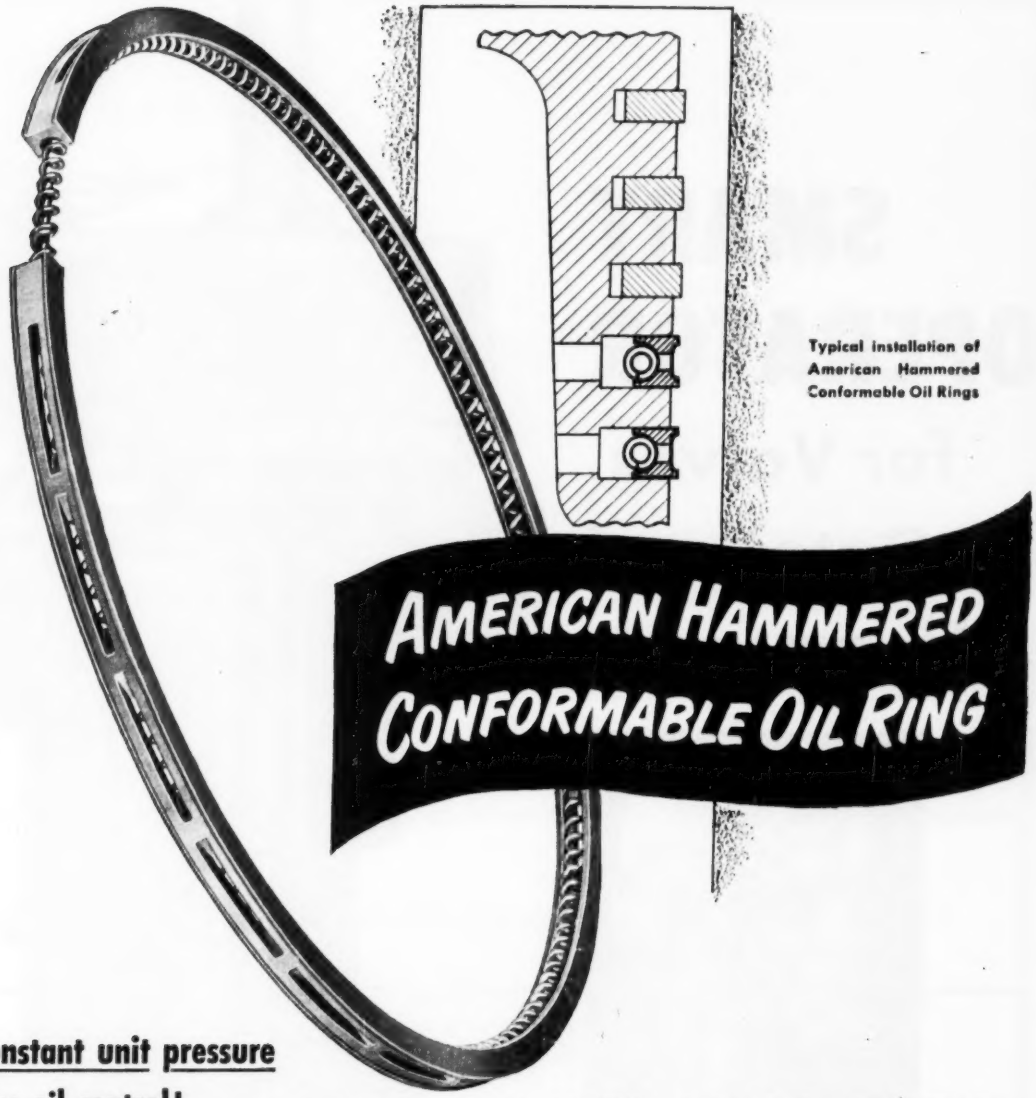


No. 850—Ten-inch, 300-pound valve equipped with 18-8 shafts, hastelloy bushings, stick lubricators and isolating valves, diaphragm top with handjack and positioner. Installed for the flow control of sour crude petroleum.

No. 801—Three-inch, 125-pound bronze screwed end valve with handlever control and locking device. There is a size and type of R-S Valve for any industry or process.

Catalog No. 20 describes R-S Valves in detail—types, prime movers, applications and specifications. Contains more than 150 illustrations. Write for your copy.





Typical installation of American Hammered Conformable Oil Rings

Insures constant unit pressure for positive oil control!

You keep your oil consumption down when you install Koppers American Hammered Conformable Oil Rings! This service-tested piston ring conforms readily to meet cylinder distortion because its flexible cast iron member is pressed outward by an abutment type spring which exerts uniform radial pressure around the entire circumference.

Narrow bearing surfaces on either side of the channel give the ring a uniform unit pressure on the cylinder, enabling it to seat promptly and assuring maximum removal of excess oil throughout its lifetime. And the Conformable Oil Ring has a longer useful life because its low spring rate and uniform lands result in negligible changes in pressure as the ring wears

Easily installed, it is ideal for both 2-cycle and 4-cycle Diesel & Gas engines; comes in 4" to 25" diameters with a minimum width of ¼". Write, wire or phone us today for full information on how the Conformable Oil Ring can improve *your* operation . . . or for expert help in *any* piston or sealing ring problem. KOPPERS COMPANY, INC., *Piston Ring Dept.*, 1632 Hamburg Street, Baltimore 3, Maryland.

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METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • Baltimore, Maryland

This Koppers Division also supplies industry with Fast's Couplings, Aeromaster Fans, Koppers-Elex Electrostatic Precipitators and Gas Apparatus.

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AMERICAN HAMMERED
Industrial Piston Rings

KOPPERS COMPANY, INC., *Piston Ring Dept.*, 1632 Hamburg Street, Baltimore 3, Md.

Gentlemen: Please send me full information on your Conformable Oil Ring.

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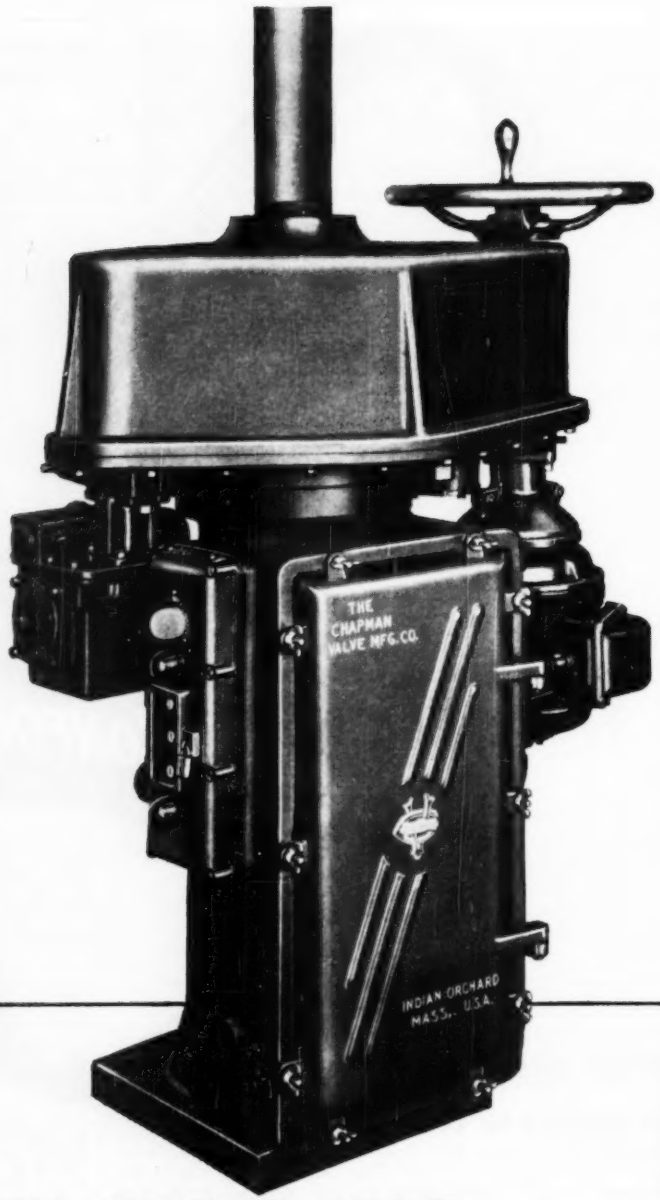
Company .....

Address .....

City ..... Zone ..... State .....

SMART OPERATOR for Valves, Gates and Floorstands



CHAPMAN'S MOTOR UNIT

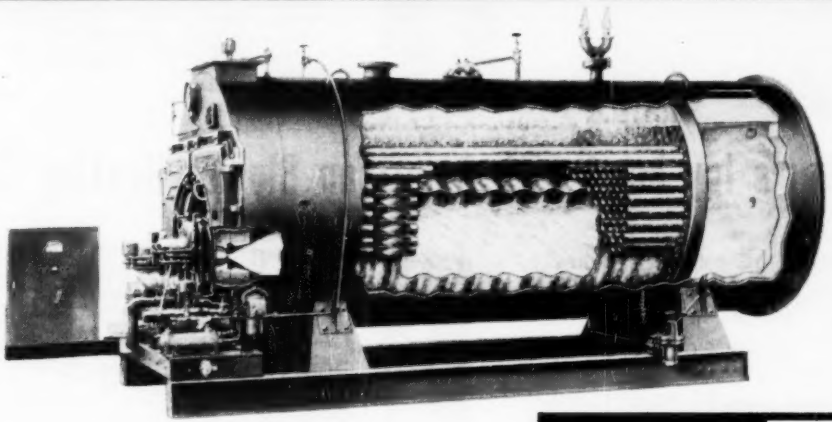
Instant control of valves and large sluice gates at the touch of a button . . . that's what you get with Chapman Motor Units on the job. Completely housed and thoroughly dust and weather proof, these units are built "to take it" for years, on the roughest service. They're designed for simplicity and extreme ruggedness, as shown by internal view above.

Chapman Motor Operated Floorstands are delivered to the job with all internal wiring complete, so all the wiring to be done is to bring the power leads into the connection box... saving time and money in installation and assuring proper operation. Write for Catalog No. 50.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

2 heads are better than 1 . . . in designing boiler-burner units

■ It is just common sense that experts in any field thoroughly know their own products. So you can expect a better product in every way when you specify the Kewanee-Petro Boiler Burner Unit because you get the combined knowledge of leadership in 2 fields . . . boilers and burners. Here, two great companies bring together boilers and burners designed as complimentary units with all parts perfectly integrated. Engineering and design have been combined for maximum efficiency and dependable production of high or low pressure steam and hot water heating using oil, gas or oil and gas combination. The Kewanee-Petro Unit is easily installed . . . simple to operate. The boiler, mounted on steel skids, has matched burner connections. All refractories are installed at the factory . . . forced draft burner eliminates necessity of a high stack . . . operation is completely automatic with all combustion controls mounted and pre-wired in one cabinet. Delivery from two separate factories offers important advantages. The boiler is usually wanted at the building site before the walls are up, and needing no protection from the weather, is shipped first. The burner, with control system, is delivered when wanted, after the building is roofed. It will pay you to get full information on this outstanding boiler-burner unit. Write either company, or mail the coupon.



KEWANEE—PETRO

boiler–burner unit

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3272 W. 106th Street, Cleveland, 11, Ohio

KEWANEE-ROSS CORPORATION
121 Franklin Street, Kewanee, Illinois

PETRO
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Please send 16 page catalog containing complete data and specifications.

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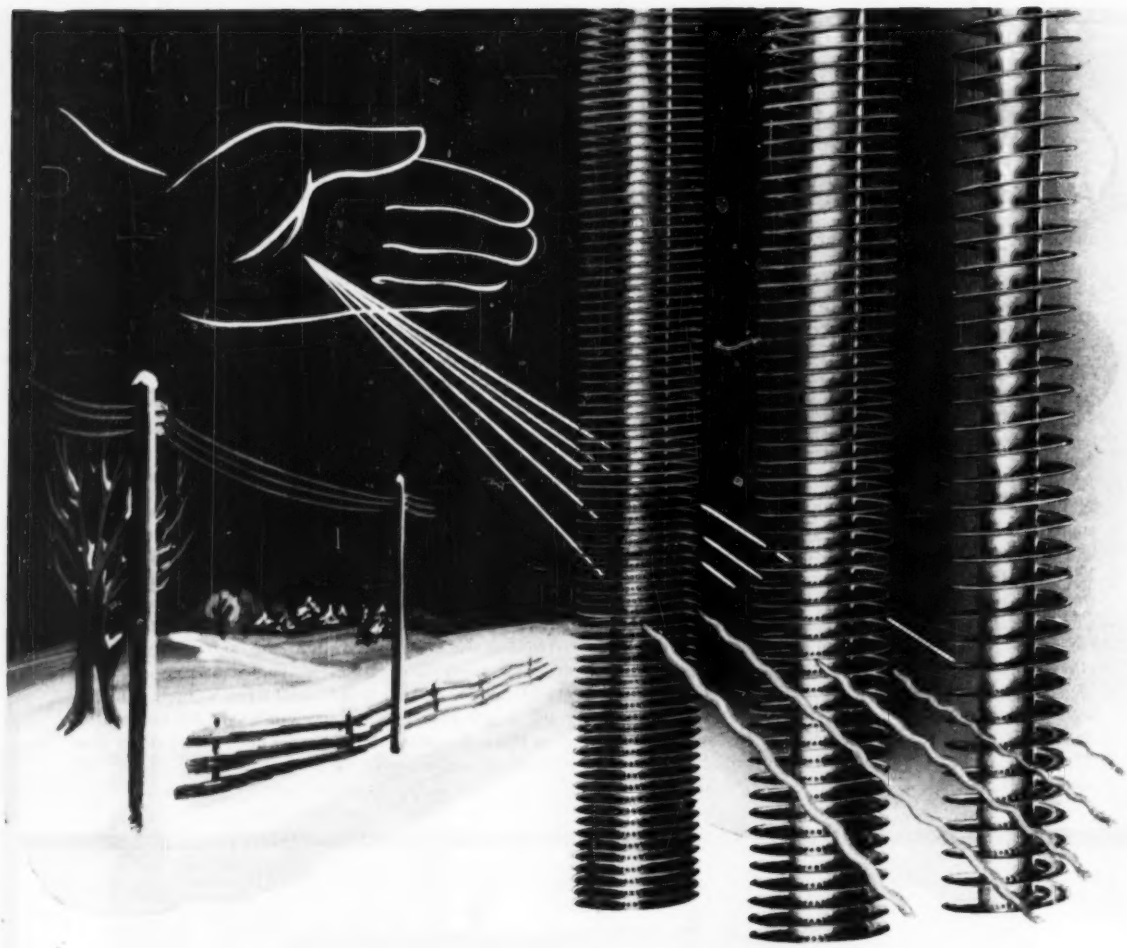
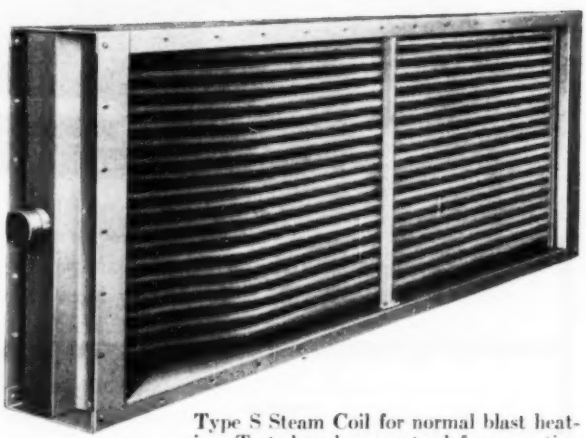


Check winter's icy hand with American Blower Heating Coils

They're quality-built. All tubing is helically wound with copper or aluminum fins in three standard spacings (see above). Coil casings are made of heavy galvanized steel; headers are of die-formed steel.

Whether you need coils for blast heating, zone reheating or whether you want return bend coils or coils for modulated steam control—you'll find the size and type that best fits your needs in the American Blower line. Write for further data.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation



Type S Steam Coil for normal blast heating. Tested and guaranteed for operation with steam up to 200 lbs. gauge pressure and 450° F temperature. Die-formed tube support protects tubes. Write for Bulletin B-1218.

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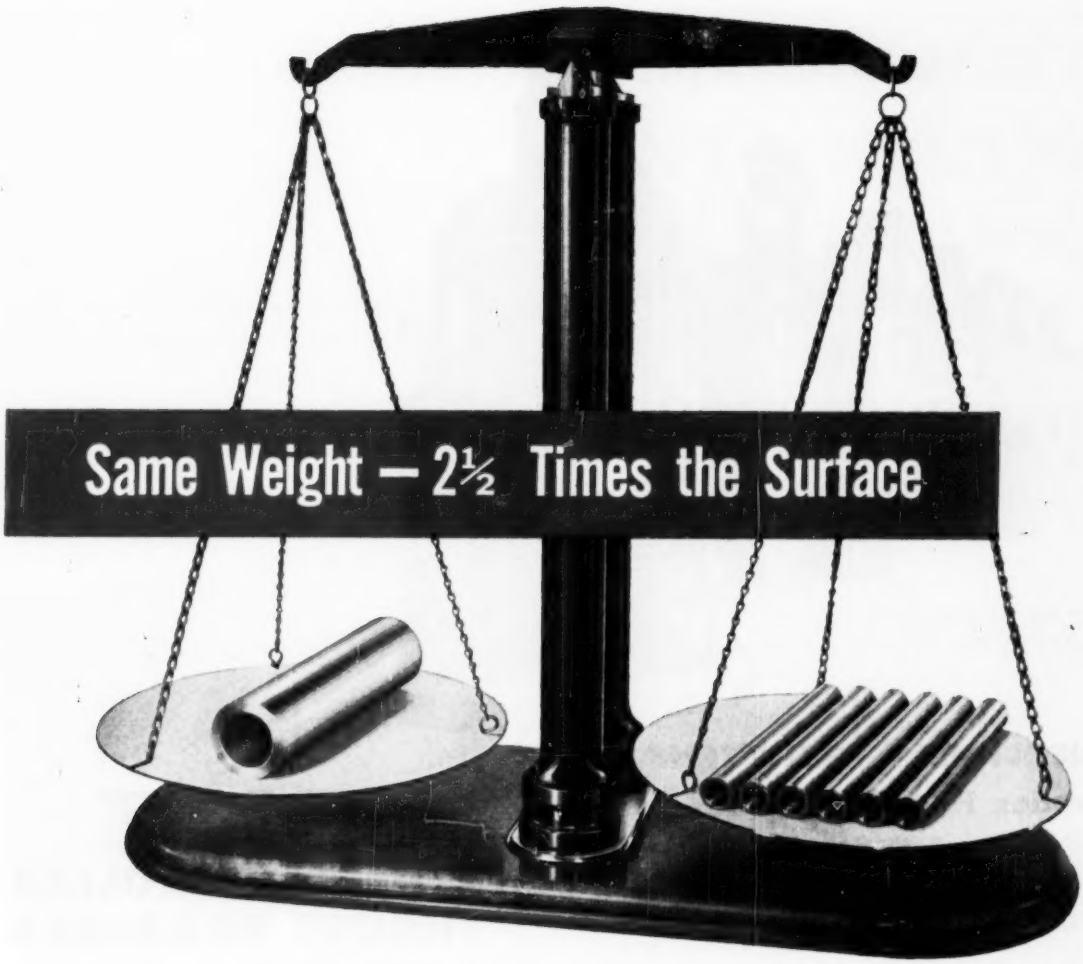
YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS



The balance scale dramatizes one of the most important advantages of controlled circulation.

On the left side is shown a 1-foot long section of conventional tubing as used in the furnace walls of a natural circulation boiler. On the right side is shown six 1-foot long sections of tubing as used in the furnace walls of a C-E Controlled Circulation Boiler. The weight is the same but the surface area of the small tubes is 2½ times greater. Because controlled circulation permits the use of small-diameter, thin-wall tubes and provides adequate and properly proportioned flow to each circuit it affords the major advantages listed at the right.

Wide recognition of these advantages by leading utilities in all parts of the country has been evidenced by orders over the past 36 months which represent an aggregate capacity of more than 6,000,000 kw.

Fifty per cent reduction in weight of steam generating surfaces for equivalent capacity.

•

Less supporting steel, less building steel and less expensive foundations.

•

Adaptability to higher steam pressures permitting better power station economy.

•

Quicker starting up and shutting down.

•

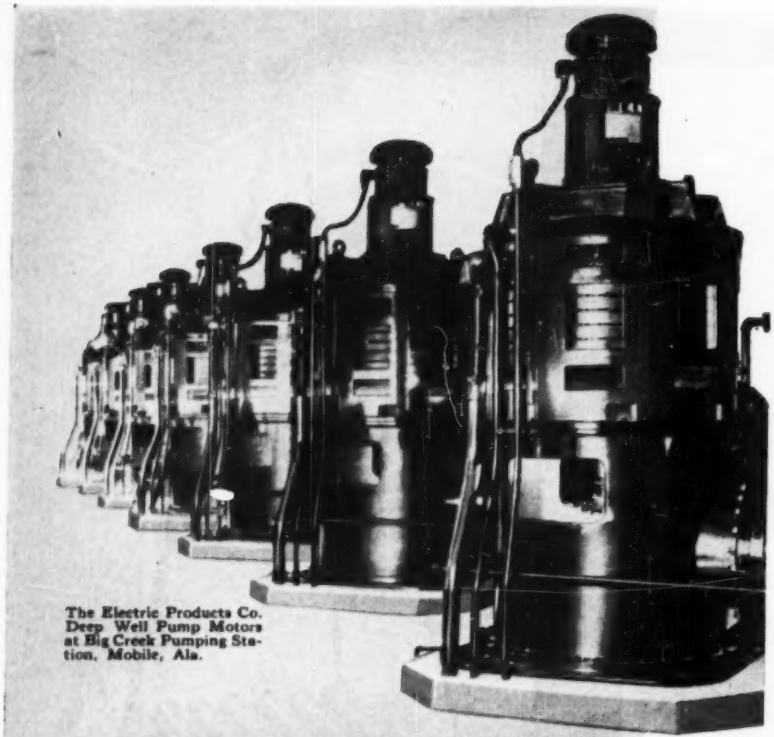
Greater safety.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT

B-660

COMBUSTION ENGINEERING, INC.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.



The Electric Products Co. Deep Well Pump Motors at Big Creek Pumping Station, Mobile, Ala.

NEGLIGIBLE MAINTENANCE under HEAVY THRUST LOAD at HIGH SPEED

The Electric Products Co., Cleveland, Ohio, is one more manufacturer who has found SKF Spherical Roller Thrust Bearings the solution to the problem of anti-friction support of heavy thrust loads at high speeds, and perfect lubrication.

Here, for example, are seven Electric Products 800 hp, 900 rpm deep well pump motors in operation at the Mobile, Ala., Big Creek Pumping Station. Under severe thrust load, high speed operating conditions, the SKF Spherical Roller Thrust Bearings in this equipment have been delivering excellent performance with negligible maintenance.

with SKF SPHERICAL ROLLER THRUST BEARINGS

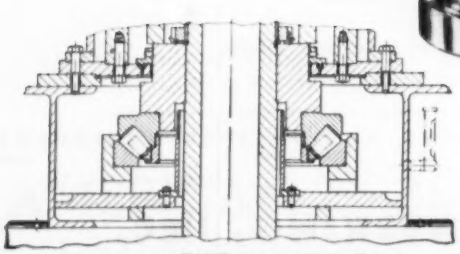
Here are the reasons why more and more equipment designers are specifying the SKF Spherical Roller Thrust Bearing:

1. The bearing has very high capacity for thrust loads, and combined loads which are predominantly thrust, especially on vertical shafts . . and can operate at high speeds.
2. It is fully self-aligning—a single row of spherical rollers roll on a spherical outer ring with full self-alignment.
3. Its inherent design is such that lubricant is pumped outwardly along the rollers against the high guide flange on the inner ring. This action assures perfect lubrication, low friction, long, trouble-free life.

SKF Bearings are serving virtually all industry. SKF's unmatched Field and Home Office engineering service helps product engineers *put the right bearing in the right place.*

7428

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.
manufacturers of **SKF** *and* **HESS-BRIGHT** *bearings.*



Cross-Section of SKF Spherical Roller Thrust Bearing as designed into the Electric Products Co.'s vertical motors at Big Creek

SKF®
BALL AND ROLLER BEARINGS

Learn how Farval can protect your machines and save you money

FARVAL—*Studies in Centralized Lubrication* No. 151

THIS new 20-page databook brings you up-to-date on centralized lubrication. In words, pictures and diagrams, Bulletin 26 shows you how simply and economically Farval systems operate.

The step-by-step operation of the unique Farval Dualine valve is presented in a series of color drawings. Its outstanding features are discussed. Detailed information on Farval systems is given, including manual systems, heavy-duty automatics, the compact automatic DC 20 specifically designed for smaller machines and the Spray Valve system designed to lubricate open gearing and slide surfaces evenly.

All about user benefits, too

Bulletin 26 also summarizes briefly the experience of Farval users. On many machines Farval eliminates 45 minutes or more out of every hour of hand-oiling labor. Farval protects bearings, thereby reducing the expense of dismantling machines. By keeping equipment steadily at work, Farval increases machine production. Farval saves 3 of every 4 pounds of lubricant used by other methods. In short, the economies due to Farval centralized lubrication usually pay for the installation in a few months and continue thereafter to pay handsome dividends.

Mail coupon today. You'll be surprised at the savings and the longer machine life you may enjoy with Farval. The Farval Corporation, 3264 East 80th Street, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company, Industrial Worm Gearing. In Canada: Peacock Brothers Limited.

FREE—Just off press! Bulletin 26 has 20 pages of photographs, drawings, diagrams and text, to enable you to select and specify the proper Farval systems to protect your machines. Mail coupon today!

Yes, please mail my FREE copy of the new Farval Bulletin 26 without obligation.

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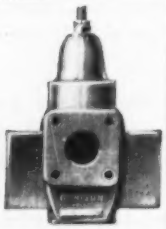
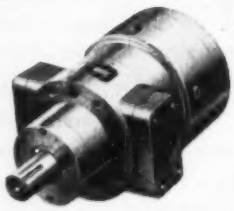
For lasting efficiency with less maintenance, specify

DENISON HydrOILic
PUMPS, MOTORS, CONTROLS
For circuit pressures to 5000 psi

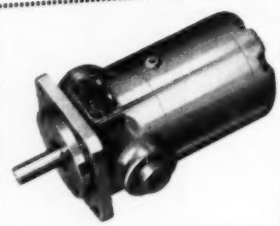
SURGE-DAMPING CONTROLS
Industrial and Aircraft Types
Eliminate Destructive Hydraulic Pressure Shock
¼" to 1" Sizes
For Pressures to 5000 psi
Catalog VS-1-A



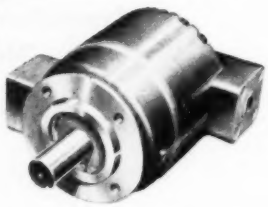
Direct-Operating PRESSURE CONTROLS
⅛" to 1½" Sizes
For Pressures to 5000 psi
Catalogs VRD-1 through VRD-8



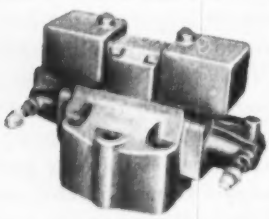
High-Pressure Axial-Piston PUMPS
Constant or Variable Volume
For 2500, 3000 and 5000 psi Circuit Needs
3.5 to 35 gpm Capacities
Catalogs P-4 through P-4-10



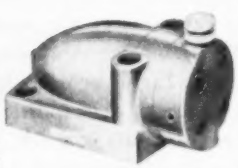
High-Torque Axial Piston FLUID MOTORS
Torque Ratings 13.8 to 112 inch-pounds per 100 psi (about 3 to 180 hp maximum)
For Pressures to 5000 psi
1500 to 3000 rpm
Catalogs FM-1, FM-2, FM-3-A



Dual-Purpose, Vane-Type PUMP/MOTOR
Ready for either pump or motor use without change
Shaft rotation in either direction
Four Sizes, 11 Models
Pumping Capacities: 3 to 82 gpm.
Motor Torque: 13 to 257 inch-pounds per 100 psi. Pressures to 2000 psi.
Bulletin P-5

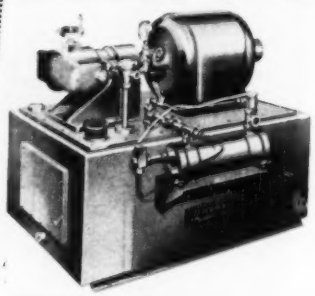


DIRECTIONAL CONTROLS
Manual, Mechanical, Electric or Pilot Control. ¼" to 2" Sizes
For Pressures to 5000 psi
Catalog VD-3



PRESSURE REDUCING VALVES
¾" to 1½" Sizes
20 gpm to 65 gpm Capacities
For Pressures to 5000 psi
Catalog VPR-1

Multi-Range FLOW CONTROLS
Full-Scale Regulation—Adjustable for Varying Input
¼" to ¾" Sizes
For Pressures to 3000 psi
Catalogs VFC-1, VFC-2



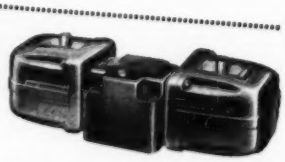
PUMPING UNITS
Constant and Variable Volume
46 Models—2 to 35 gpm Capacities
For Pressures to 5000 psi
Bulletins PU-3-A, PU-4 and PU-5

PROVED IN USE
under industry's toughest operating conditions

Denison HydrOILic Pumps, Motors and Controls are noted for their combination of high efficiency and rugged dependability.

In addition to fine performance under continuous, heavy-duty use, Denison HydrOILic Equipment offers space-saving design that simplifies circuit layout, makes installation easier, and minimizes maintenance problems.

Because so many users verify the extra value built into Denison Pumps, Motors and Controls, we continue the challenge made so often before—*let comparison prove to you* why they are first choice for so many needs of every type. Write today for full details on Denison HydrOILic Equipment to meet your requirements.



Pilot-Operated, Solenoid-Controlled DIRECTIONAL VALVES
Eliminate Spool-Sticking
¾" to 1½" Sizes, For Pressures to 5000 psi
Catalogs VD-1-1 to VD-4-2

Hydraulically Balanced PRESSURE CONTROLS
¾" to 2" Sizes
For Pressures to 5000 psi
Catalogs VR-2-B and VR-5-2

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PUMPS | MOTORS | CONTROLS | PRESSES

"The Finest Money Can Buy!"

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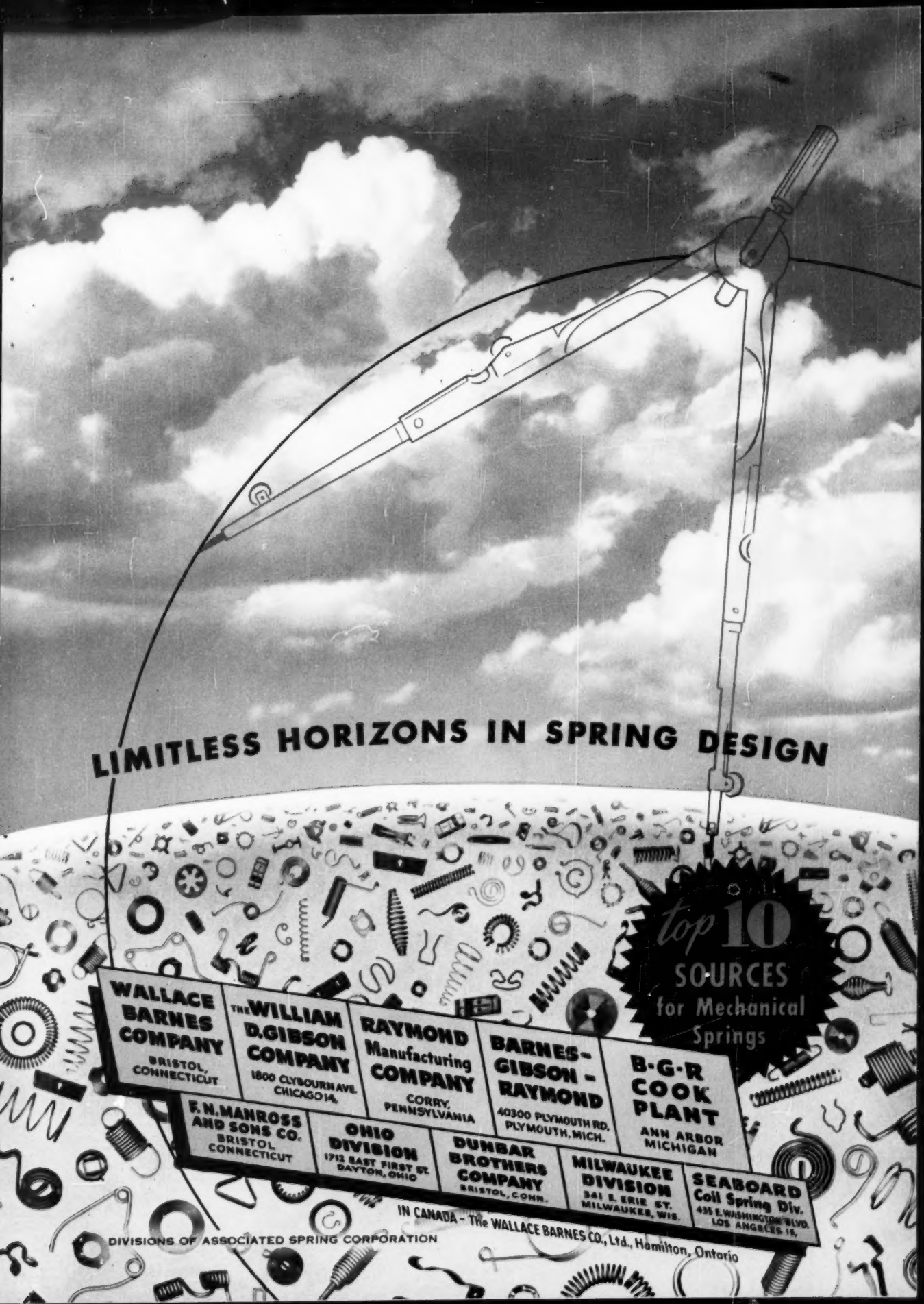
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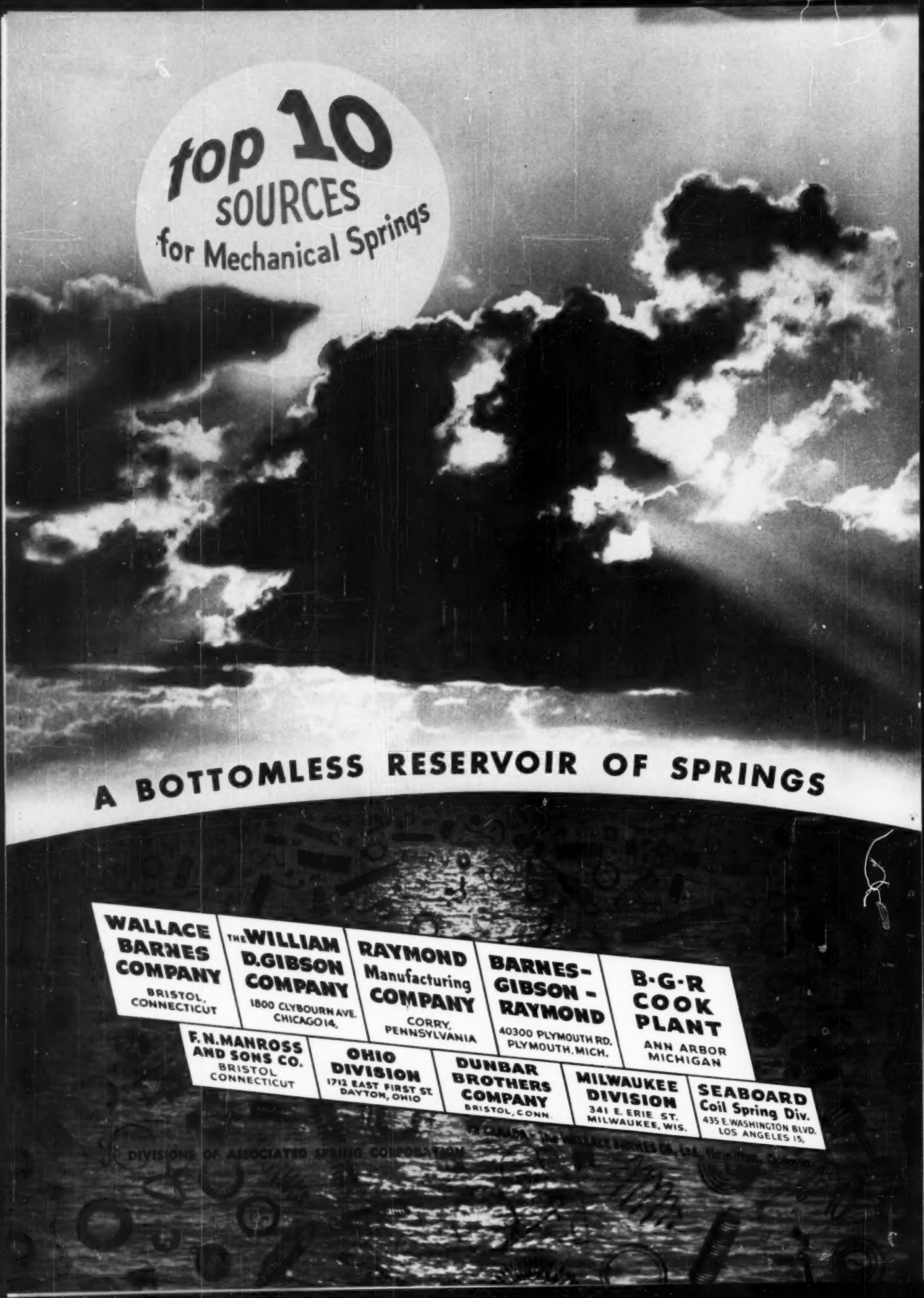
DIVISIONS OF ASSOCIATED SPRING CORPORATION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A BOTTOMLESS RESERVOIR OF SPRINGS
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Where weight and space are critical

New miniature transducers expand the scope of dynamic recording systems

A BASIC PROBLEM in transducer design is reduction of size to a point where characteristics of the device under test are not affected. Two new transducers developed by Consolidated combine unusually small size and weight with operating characteristics fully comparable to previous larger instruments.

The 4-310 Pressure Pickup features a direct-sensing diaphragm and is mountable flush with any surface to avoid both volume changes in the pressure chamber and spurious turbulence patterns. It is valuable for aerodynamic pressure surveys and other high-frequency liquid or gaseous pressure measurements.

The new 4-118 Velocity Pickup is usable at high temperatures in any plane of orientation. Its output equals instruments many times its size and weight, yet it has no loading effect on structures being tested. Applications include turbine, supercharger, rocket and jet engine vibration studies.

4-310 pressure pickup

Sensitivity: 4 mv/v of applied excitation.

Ranges: 5, 15, 50, 150 psi.

Temperature range: —100°F to +250°F.

Sensitive element: 350-ohm, 4-arm resistance bridge.

Excitation: ac or dc.

Linearity and hysteresis: excellent characteristics.

Acceleration response, zero and sensitivity drift: negligible.

Versatility: usable for liquid or gas measurements.

Size: diaphragm diameter ½", length ⅝".

Complete specifications in Bulletin 1534A-X1.

4-118 velocity pickup

Output: 100 mv/in./sec. @ 250 cps.

Frequency range: linear ±10% from 50 to 500 cps over range of —65°F to +500°F.

Amplitude limits: to 0.12" peak-to-peak.

Transverse sensitivity: negligible.

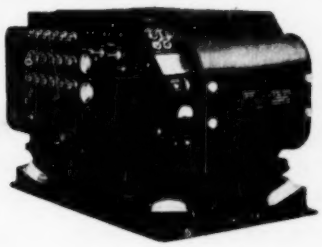
Sensitive element: self-generating, nominal 700-ohm dc coil resistance.

Total weight: 1.3 ounces.

Size: ¾" diameter, height 1".

Complete description and specifications in Bulletin 1535-X1.

Vibration can be easily, precisely measured and monitored by combining the Velocity Pickup with Consolidated's Vibration Meters, described in Bulletin 1505B.



Transient or high-frequency vibrations and pressure changes can be recorded for detailed study with Consolidated's Recording Oscillographs. Send for Bulletin 1500B.

Consolidated Engineering

CORPORATION

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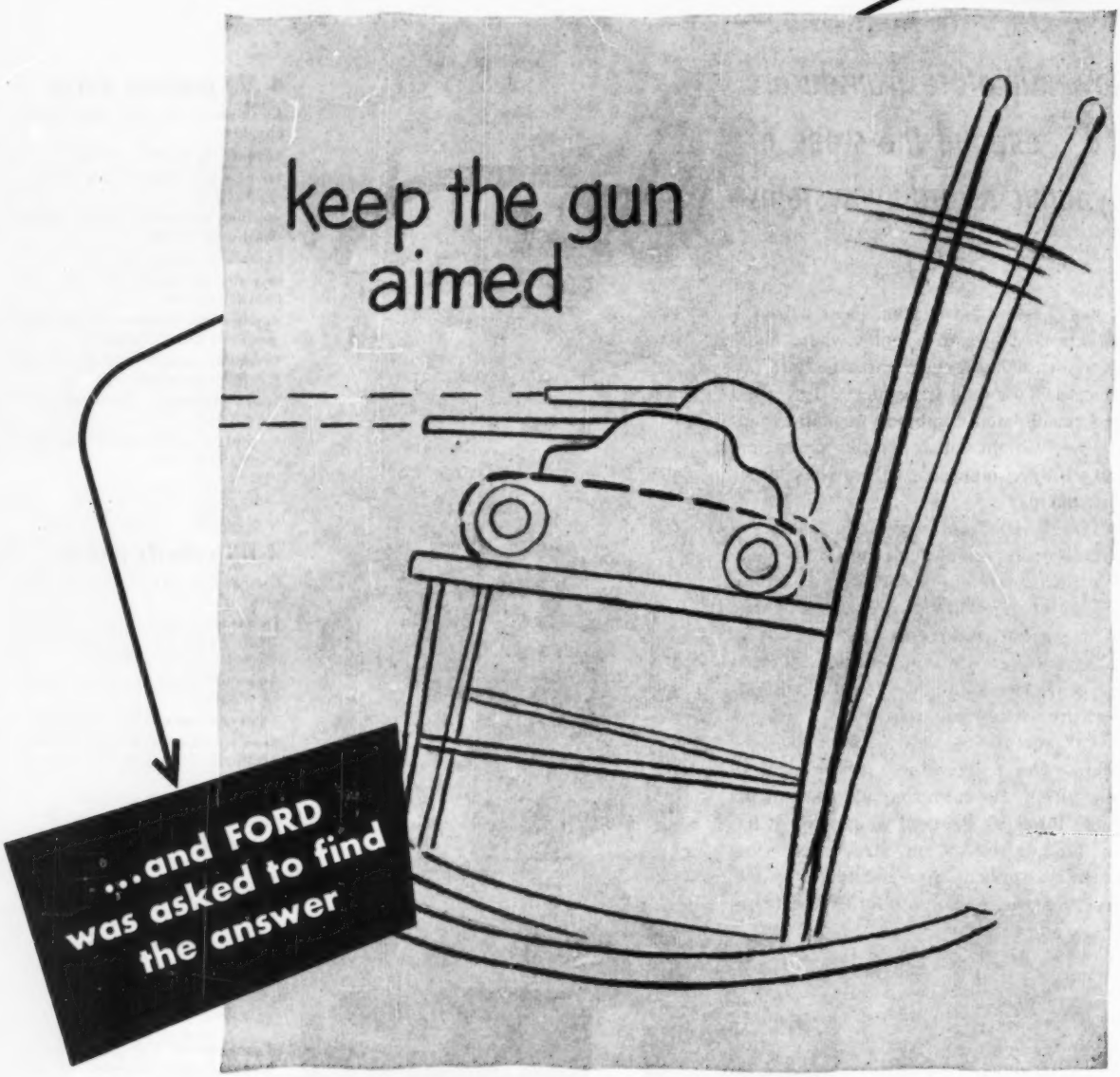
Sales and Service through **CEC INSTRUMENTS, INC.,** *a subsidiary with offices in: Pasadena, New York, Chicago, Washington, D. C., Philadelphia, Dallas.*

analytical instruments for science and industry

Miniature transducers

Consolidated's new miniature transducers, among the smallest ever designed for pressure and vibration measurement, are adaptable to the most exacting mounting requirements.

TO KEEP GUNS STABILIZED
over rough terrain



Over open area a tank pitches and heaves like a rocking chair . . . but regardless of the bumps . . . ditches . . . hills . . . the guns keep pointing at the target while the tank is moving. Ford Instrument Company played a vital role in designing and manufacturing a stabilizer unit for the tank's gun fire control system.

This is typical of the problems that Ford has solved since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic electro-mechanical, magnetic and electronic instruments that bring us our "tomorrow" today. Control problems of both Industry and the Military are Ford specialties.

7

You can see why a job with Ford Instrument Company offers a challenge to young engineers. If you qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

FORD INSTRUMENT COMPANY
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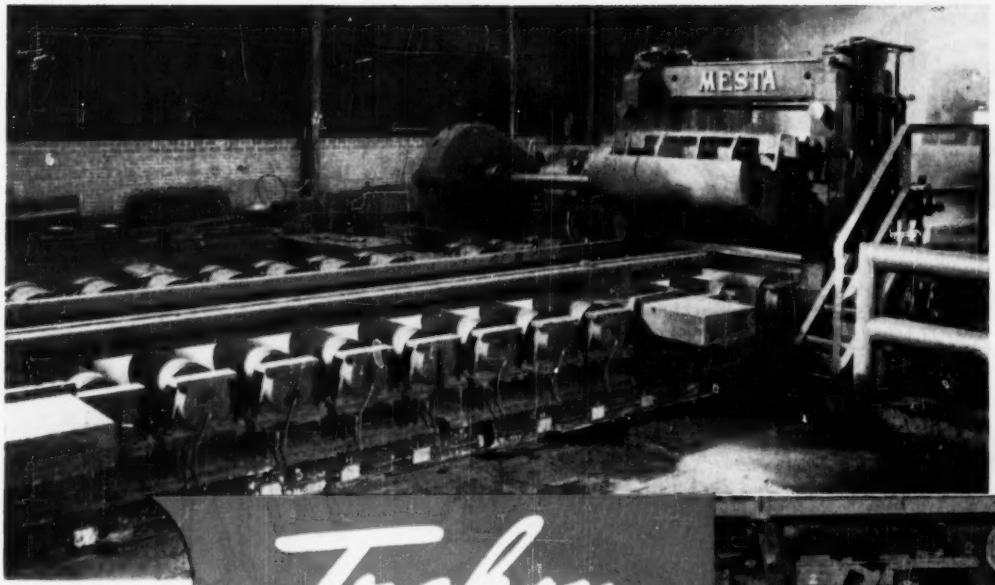
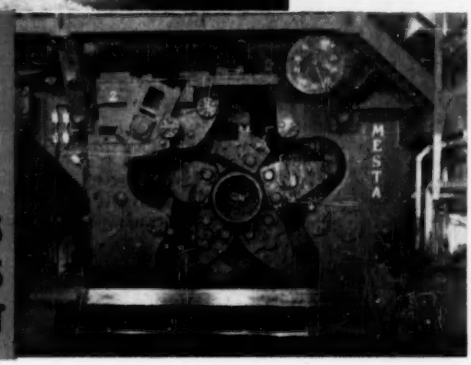


260-point, newly designed, run-out table at Allegheny Ludlum, automatically lubricated by Trabon.

11 bearings on the revolving mandrel of this Allegheny Ludlum coiler are quickly and easily lubricated by Trabon.

Trabon

LUBRICATES 3800 BEARING POINTS AT ALLEGHENY LUDLUM PLANTS IN PITTSBURGH DISTRICT



this has a BEARING on the subject

Here at one of the country's leading steel companies is a good example of dependable, versatile **TRABON** automatic lubrication at work. 3800 points on a wide variety of equipment . . . hot strip mill, cold tandem mills, soaking pits, furnaces . . . are being lubricated by Trabon systems.

There are good reasons for Allegheny Ludlum's choice of Trabon automatic lubrication systems:

- Trabon engineering service assures the best in design, fabrication and installation.
- It's a *positive* system—a single indicator at the pump to tell the operator when all bearings have been lubricated.
- It's completely sealed so that it operates effectively even underground and is unaffected by steam, dirt or snow.
- Trabon systems, for either oil or grease, fit any bearing situation.

Write for more information today.

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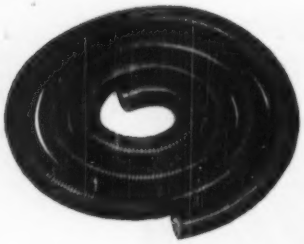
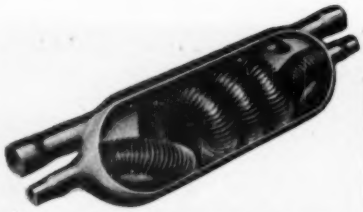
Oil and Grease Systems

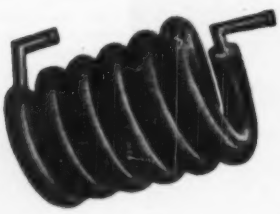


This flat pancake type coil, measuring 9" across, contains 5½ feet of Wolverine Trufin*—the integral finned tube—in its 3½ turns.



Shown here is a heat exchanger containing 25" of Wolverine Trufin* coiled within a 2½" O.D. copper shell whose ends have been reduced by the Wolverine Spun End Process†. This is a good demonstration of the ease with which Trufin can be fabricated.

A simple form fabricated from seamless copper tube, utilizing the Wolverine Spun End† Process. By producing the part this way, you enhance its appearance—effect many economies and in most cases, eliminate "extra-part" assemblies.



The illustration on the left shows how Trufin may be coiled as easily as plain tube. Pictured to the right is one coil nested inside the other. The finished coil is approximately one foot high and 5" in diameter; the total length of the tube is 63 feet.

This shows serpentine coil to get maximum length in a small space, all on one plane. Both ends have been beaded to facilitate hose connections.

Are you about to design a Tubular Part?

In designing a tubular part, which will become a component of your main product, what will you strive for? Attractive form? Speed in production? Economy?

Wolverine can help you at every turn.

Wolverine has the skill and necessary equipment to produce nearly any tubular shape you specify—in copper, copper-base alloy, or aluminum.

In collaboration with its customers, Wolverine has designed many tubular parts which have effected increased efficiency and worthwhile savings. The product was re-designed so it could be made in a fraction of the time previously required.

Additional economy was also realized in a reduction of component parts needed, which resulted in reductions in assembly time.

You should get many helpful suggestions from our Fabricated Parts Book. We will be glad to send it to you on request.

*REG. U. S. PAT. OFF.
†A PATENTED PROCESS RE. 22465

Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario.

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of CALUMET & HECLA, INC.

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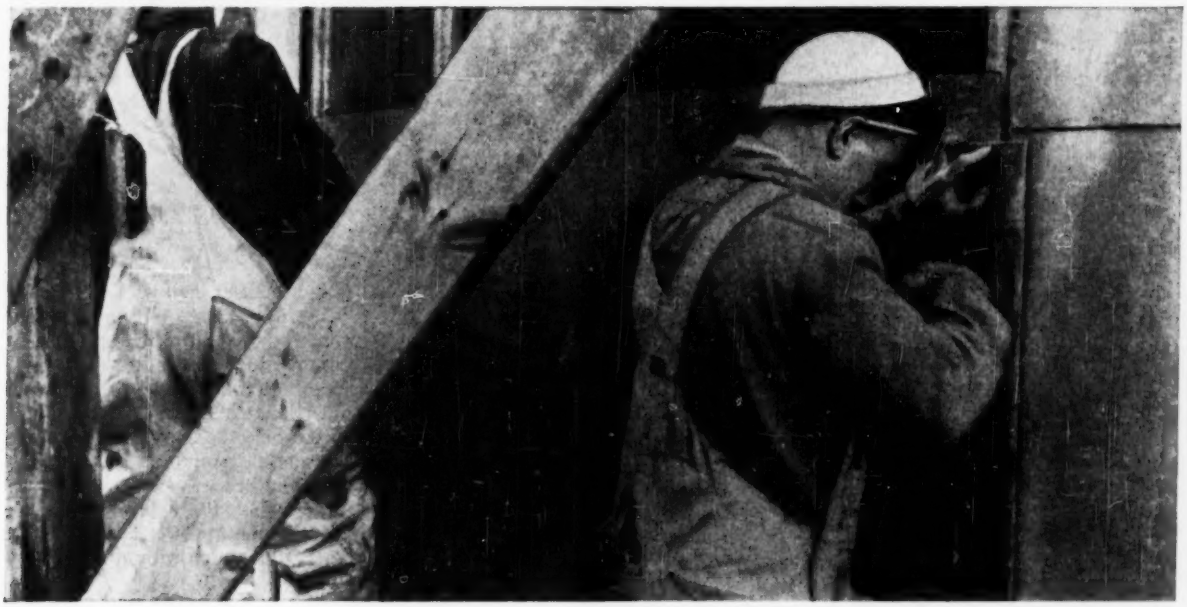

To insulate outdoor tanks with complete weather protection, these skilled J-M applicators follow a specification developed by Johns-Manville. Here they are fastening J-M Asbestocite* Sheets over J-M Zerolite* Insulation. J-M 85% Magnesia Insulation is also widely used for this type of equipment

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1. You get dependable materials—Johns-Manville manufactures a complete line of insulations for every service temperature from minus 400F to plus 3000F. From them your J-M Insulation Contractor can select the right insulation for the most dependable service on your job. To develop new and improved insulation materials Johns-Manville maintains the J-M Research Center—largest laboratory of its kind in the world.

2. You get dependable engineering—For 95 years Johns-Manville has been accumulating insulation engineering experience. J-M Insulation Engineers are called upon to solve insulation problems of every type and magnitude, in every industry. Since your J-M Insulation Contractor works closely with J-M Insulation Engineers, he brings to *every* job a high degree of training, skill and experience.

3. You get dependable application—Johns-Manville has set up a nationwide organization of J-M Insulation Contractors to serve you. These Contractors maintain staffs of insulation engineers as well as skilled mechanics thoroughly trained in J-M's proved application methods. You can have absolute confidence in their ability to apply J-M insulations correctly for trouble-free performance.

For further information and the name of your J-M Insulation Contractor, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.

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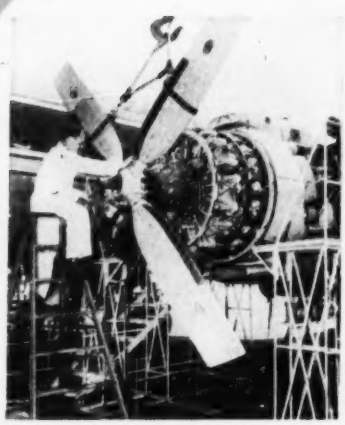
Headquarters for VIBRATION CONTROL

LORD Dynafocal Engine Mountings

ON THE NEW DC 7

DOUGLAS



Safety . . . Speed . . . Comfort characterize the new Douglas DC 7, "the world's fastest piston-powered commercial airliner". Contributing to these factors, Lord MR43 Dynafocal Engine Mountings and Bonded-Rubber parts control vibration throughout the aircraft.

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TWO TERRY TURBINES IN RECORD NON-STOP RUN AT CITIES SERVICE

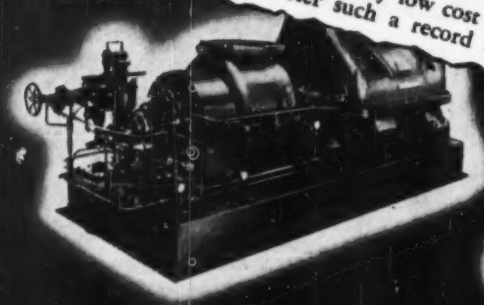
After 26 Months of Continuous Operation, Cost of Replacement Parts Only $78.00 for Each Turbine

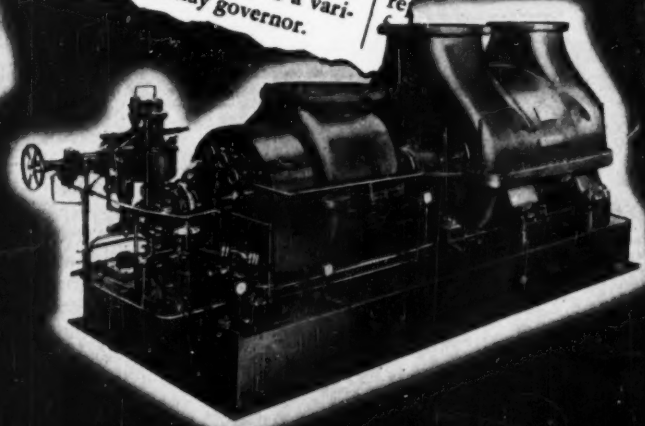
Two Terry turbines recently completed a record non-stop run at the East Chicago refinery of Cities Service Oil Company. Specially designed for driving air blowers on fluid catalytic cracking, tney ran continuously *from initial start up*, day and night, for two years and two months. Throughout the entire run neither turbine suffered any noticeable reduction in efficiency.

On inspection, after shutdown, it was found that the only parts showing signs of wear were the shaft packing rings. These were replaced at a total cost of $78.00 for each turbine.

While this extremely low cost for repairs, after such a record run, could not have been anticipated, Cities Service had good reason to expect outstanding performance from Terry turbines. A four-year record of 216 Terry turbines at the Lake Charles refinery of this same company showed amazingly low maintenance costs. During this period, the yearly cost of replacement parts averaged only 1.4% of the initial investment.

The two turbines at East Chicago are rated 2450 horsepower at 5030 rpm. Each is equipped with a trip throttle valve, forced feed lubrication, and regulator for process control applied to a variable speed oil relay governor.





For more information about Terry multistage turbines, send for a copy of Bulletin S-146. No cost or obligation.

TERRY

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TT-1193

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This TUBE-TURN Concentric Reducer is designed with the smoothest reductions and the strongest knuckle contours consistent with adequate tangent lengths and the end-to-end dimensions established for this type fitting by the American Standard. TUBE-TURN Reducers are superior to the pipe in bursting strength and their fatigue life equals that of the butt weld used to join them to the pipe.

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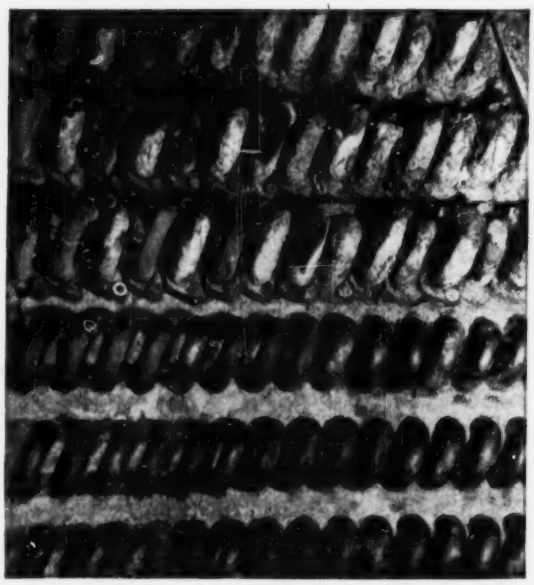
TUBE TURNS' *Engineering Service*

shows the way to eliminate equipment shutdowns

● In the past, directional changes in the tubes used in fuel economizers for boilers have been made with flanged U-bends or with header boxes. Although leakage was inevitable sooner or later, and repairs difficult, such conventional connections were necessary to permit periodic dismantling and mechanical cleaning.

Now, improved methods of water treatment have eliminated the need for such cleaning in most cases, and with it, the need for joints that can be readily disassembled. Accordingly, TUBE TURNS' Engineering Service has recommended re-fabricating tube assemblies with TUBE-TURN 180° Welding Returns, which are available in thicknesses and radii to match the tube walls and centers of most economizers.

The result has been the elimination of any leakage in economizer tubing, thus ending shutdowns of economizers, boilers, and other critical equipment. In addition, pressure drop is reduced, and flow conditions improved. When you have a tough piping problem, bring it to TUBE TURNS' Engineering Service—a service that typifies TUBE TURNS' leadership in piping engineering.



At top: flanged connections in economizer. *At bottom:* permanently leak-tight TUBE-TURN Welding Returns.

Shop fabrication of welded piping assemblies is easy, thanks to the uniform wall thickness and dimensional accuracy of TUBE-TURN Welding Fittings. Line-up is fast and accurate.

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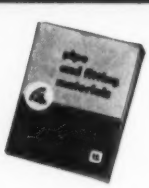
[illegible] has prepared a booklet [illegible] progressive [illegible] of pipe and tubing [illegible] corrosion [illegible] and covers a host [illegible] nickel and nickel [illegible] has a [illegible] and also a [illegible]



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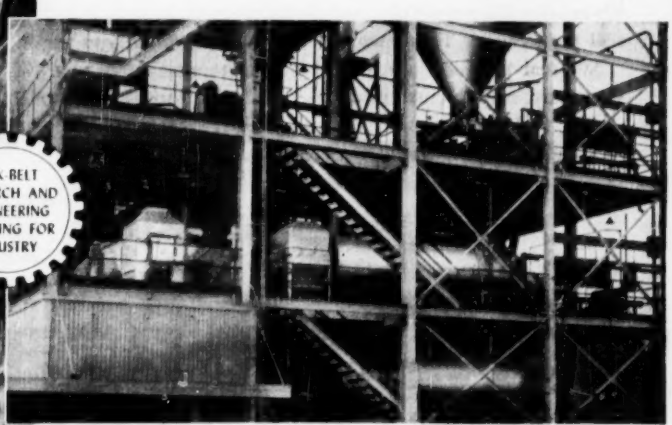

Ammonium nitrate plant, shown before completion of building, reveals variety of Link-Belt equipment used in conveying, drying, cooling, mixing, elevating, screening. For complete facts on Link-Belt equipment for commercial fertilizer plants, send for Book 2459.

Photo (left) courtesy Farm Quarterly

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When you see this fillet of alloy, **and the fitting is Walseal** you know that you have full penetration because the alloy comes from the inside.

Cutaway view of a Walseal Tee showing: 1 — **factory-inserted ring** of silver brazing alloy; 2 — fillet of silver brazing alloy that appears upon completion of Walseal joint; 3 — cutaway view of the completed joint showing that silver brazing alloy has flowed in **both** directions from the factory inserted ring.

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No lost time or motion in handling the alloy . . . no difficulty in getting *full penetration* of the alloy regardless of the position of the valve or fitting . . . no guessing whether the joint is made right . . . the fillet of silver brazing alloy that shows up when the Walseal joint is completed, *comes from the inside!* And, whether you've made the joint yourself, or are inspecting the work of another, you know that if the silver alloy fillet is visible, *and the valve or fitting is Walseal,* you have full penetration. That's why nobody guesses when you use Walseal!

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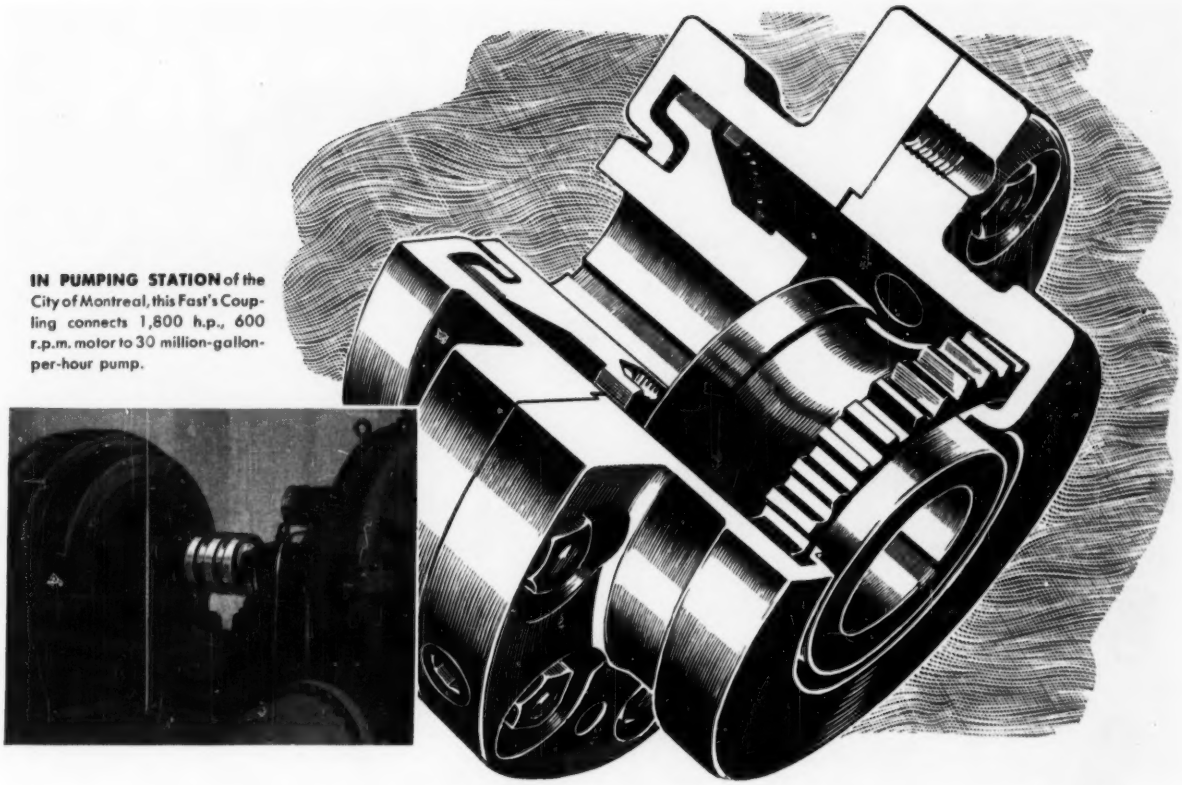

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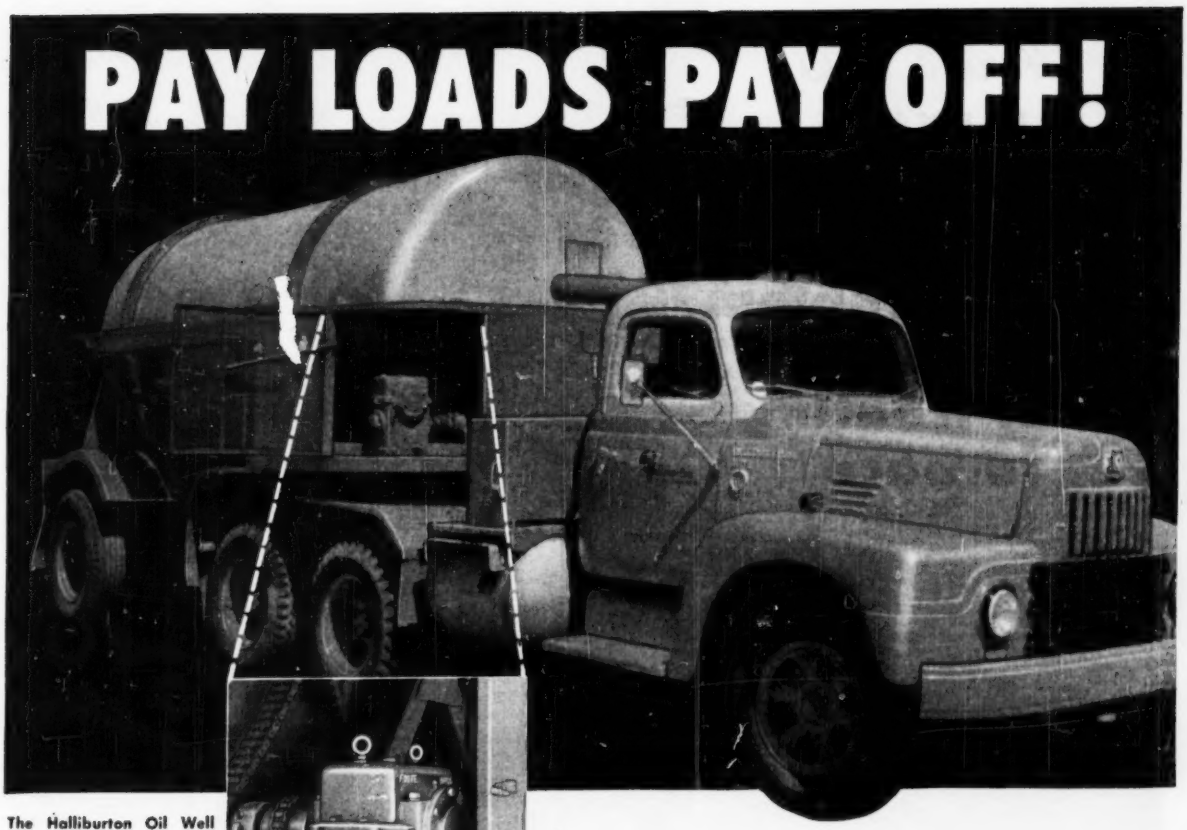

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Install 'em in your plant — even mount 'em on your trucks — *wherever* tough jobs call for rugged, space-saving drives — the Foote Bros. Hygrade line can solve your problem.

Hygrade worm gearing is skillfully engineered — precision generated — assures you greater efficiency, maximum power. Sturdy construction, improved design, compact housings — all offer you the savings on maintenance, the superior performance you've been looking for.

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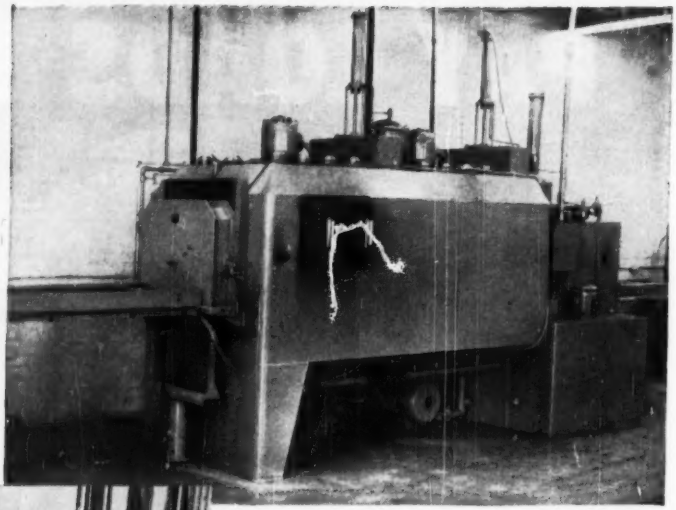
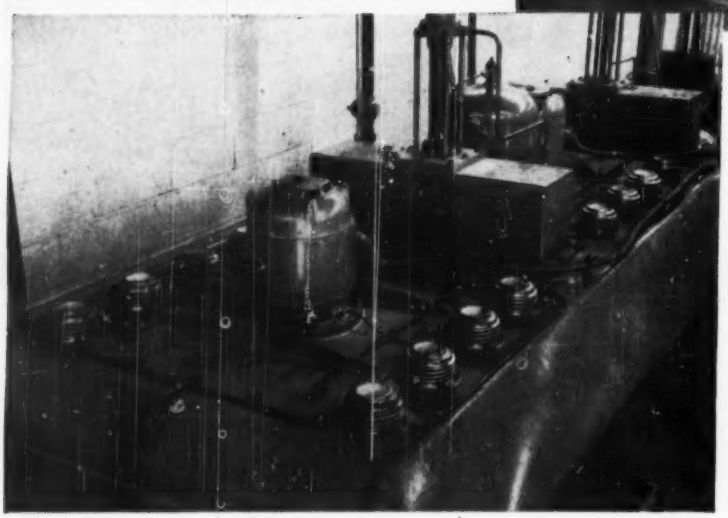
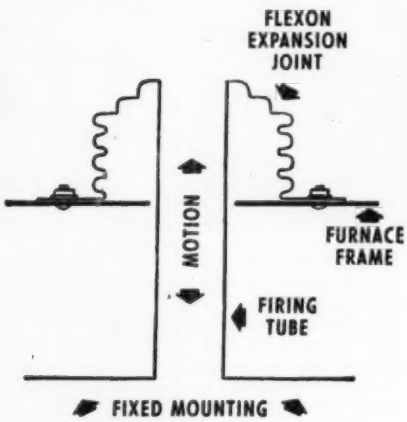
Here's how

FLEXON EXPANSION JOINTS solve a difficult motion problem in this heat treating furnace







In the heat treating furnace illustrated above, which is manufactured by Ipsen Industries, Rockford, Ill., the unit is brought to temperature by burning gas in vertical tubes that extend through the furnace. Thermal expansion of these tubes at 1000° F. presented a mounting problem that was solved by attaching the free end of the tube to a FLEXON Expansion Joint, which in turn is mounted on the furnace frame as shown in the drawing. To combat the high temperatures and corrosive conditions, the expansion joints are fabricated from No. 321 stainless steel.

This is the type of problem that is a specialty of Flexonics Corporation. Whenever you have a connection problem, whether it be caused by expansion, flexation or vibration, let Flexonics know-how solve it for you.

Flexonics Catalog No. 128 gives full information on Flexon Expansion Joints and other motion control problems. See also the Flexonics catalog in Sweet's.

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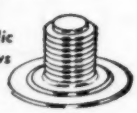

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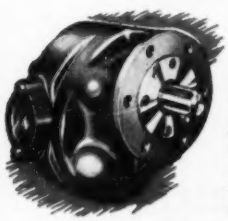

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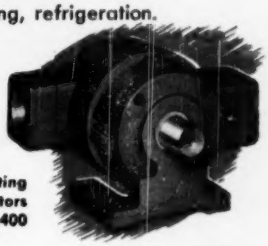
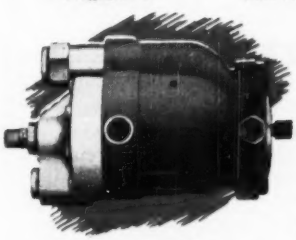
Reversible and non-reversible Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.



DUDCO
DUAL VANE TYPE PUMPS

DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in dual units operating from a single drive. Hydraulic motors with starting torque outputs to 14,400 lb. in.



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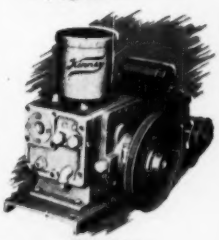

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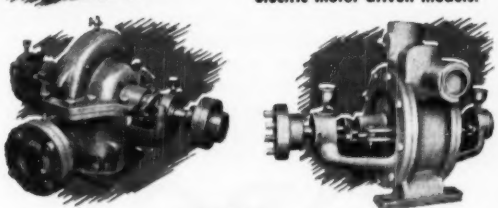
Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.



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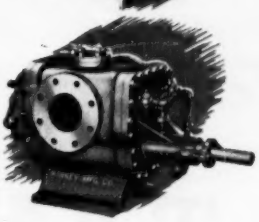
Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.



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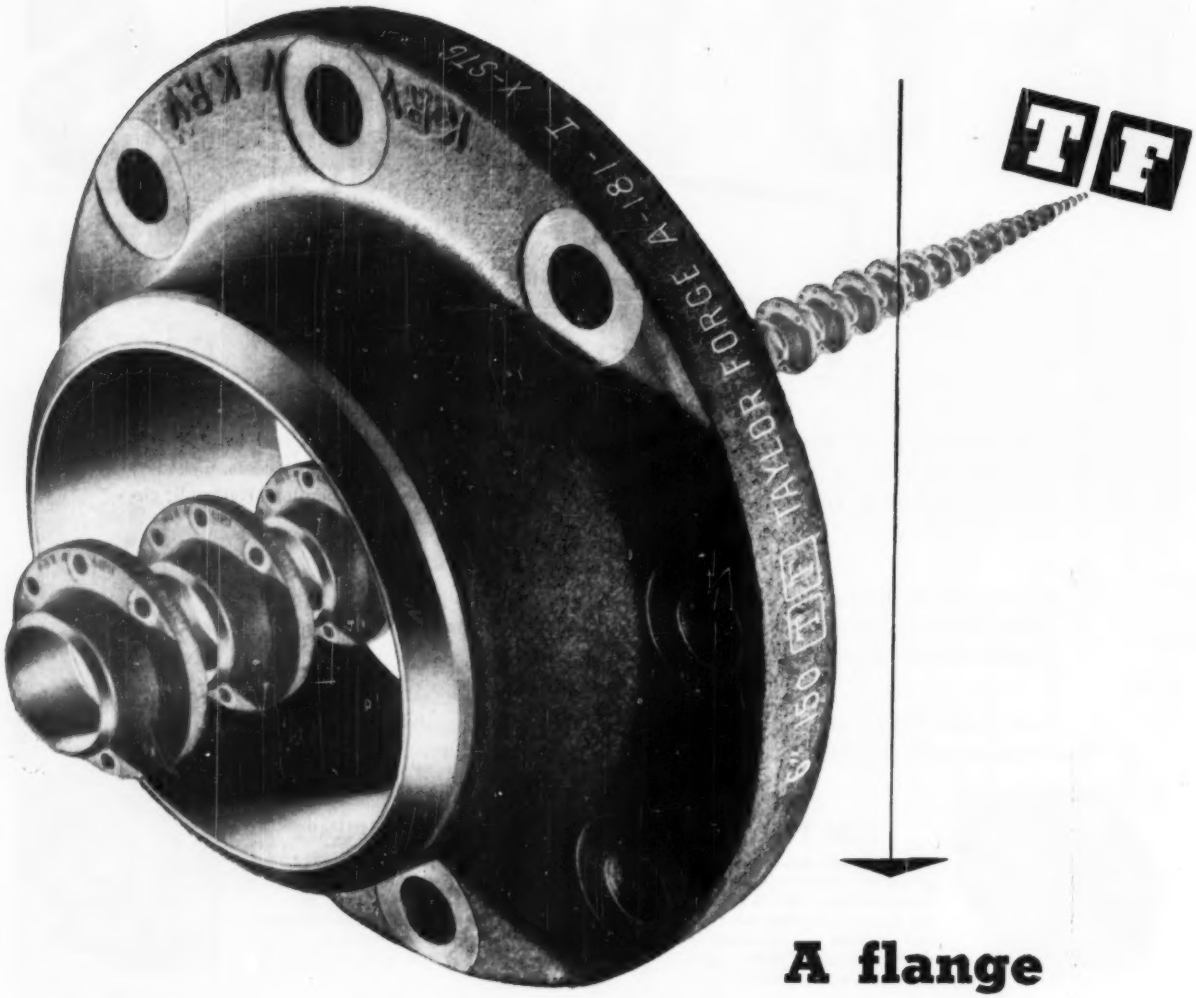

A flange with a background . . .

You are looking at a flange with a history. Taylor Forge made the forged steel flange and in a sense the forged steel flange made Taylor Forge. It was Taylor Forge, back in 1905, who made the first forged steel flanges on a commercial scale . . . and it is Taylor Forge who has guided flange development across the past half century.

Through the first threaded flange form, the bolted Van Stone form, and the perfected welding neck form pictured here, Taylor Forge has undeniably contributed more to flange development than any other organization*.

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* When pressures rose from the old 150- and 300-pound standards to 400, 600 and finally 900 pounds, it was largely the exhaustive research of Taylor Forge that supplied the formulas for determining stresses in flanges for any given condition of loading. Among many examples: the Taylor-Waters formula, published in 1927, became and still is the basis of recognized practice for flanges in sizes through 24". Again, in 1938 Taylor Forge published the first edition of the now authoritative "Modern Flange Design" based on methods proposed by E. O. Waters, D. B. Rossheim, D. B. Wesstrom and F. S. G. Williams, Taylor Forge Manager of Engineering Standards. (ASME Trans., Apr. 1937)

FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*

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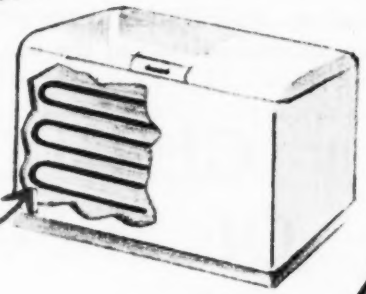
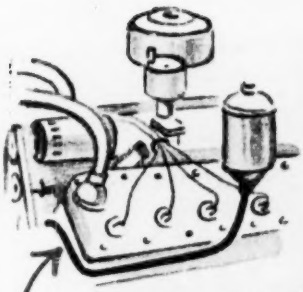
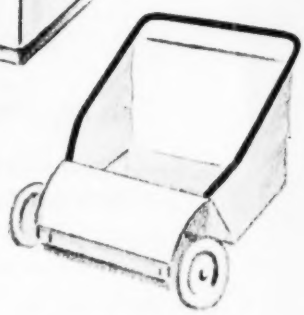


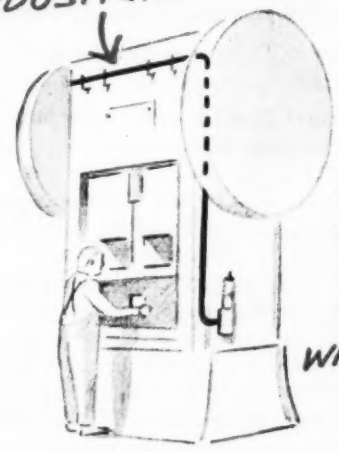


TIMING GEAR OIL LINE

FRAME FOR LAWN SWEEPER



LUBE LINES ON INDUSTRIAL PRESSES



REMARKS Perhaps you can improve your product -- with Bundyweld Tubing. For instance, you can end tubing-leakage worries. Or make your product lighter and stronger. Perhaps you can bring production costs down, too. Talk things over with our engineers.

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Ductile

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Machines easily
Takes plastic coating
Takes plating
Bright and clean
No inside bead
Uniform I.D., O.D.

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← **NOTE** the exclusive patented Bundyweld beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.

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Bundyweld nickel and Monel tubing is sold by distributors of nickel and nickel alloys in principal cities.

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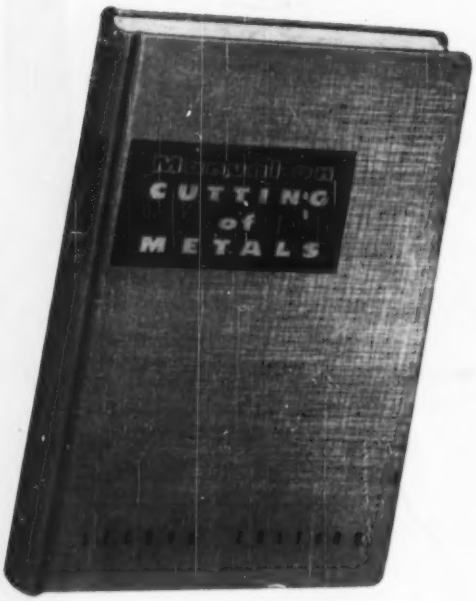

For specific, detailed information on all phases of machinability with single-point tools and for the kind of help that cuts costs, steps up production, and standardizes practice, look to the new second edition of the manual on

CUTTING OF METALS

545 Pages 5½" x 8½" 200 Illustrations 382 Tables $10.00.

Prepared by the ASME Committee on Metal Cutting Data with the collaboration of twenty-two specialists.

The Manual covers the machining of a variety of metals including high-nickel alloys, stainless steels, copper and its alloys, magnesium, cast irons, and plastics, explaining the influence of their mechanical characteristics and structure on machinability, chip formation and control, and surface finish. Types and sizes of tools, tips, inserts, and holders are considered and tool performance evaluated. Composition, types and functions of cutting fluids and their effects on cutting speeds are covered; also the forces, power, and cutting speeds for specific conditions when turning a variety of metals. Cutting, idle and loading time, tool changing, and grinding costs are analyzed, and a cost per piece formula is presented along with an example showing how costs are calculated.

Besides this fund of new information there are 320 tables reproduced in full from the first edition covering the machining of thirty-five commonly used steels by seven differently shaped tools; the cutting speeds and the horsepower required for seven speeds varying from 0.002 to $^1/_8$" each for nine depths ranging from $^1/_{32}$ of an inch to one inch; data from which values may be derived for a more complete list of 289 steels and conditions; and for computing similar information about the turning of 27 cast irons and 34 nonferrous metals.

CONTENTS

Types, uses, and preparation of single-point tools — Nomenclature, standard types, tool materials, grinding, evaluating tool performance.

Mechanical characteristics and structures of work material.

Definitions, functions, and classification of cutting fluids — Influence on cutting speeds, best ratio of depth to feed, practical cutting fluid recommendations.

Cutting forces; gross and net power at the cutter — Tools, speeds, and feeds for machining.

Net unit power for machining a great number of metals using a single size of cut — Formulas for computing power required for other cuts, correction factors for various tool angles, computation of motor capacity requirements.

Economics of metal cutting.

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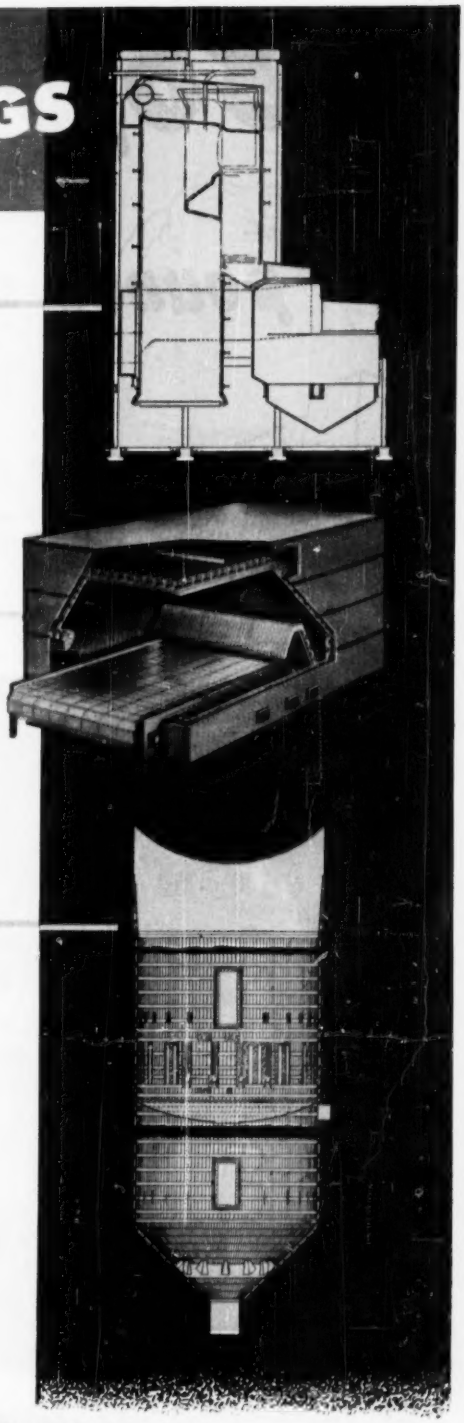

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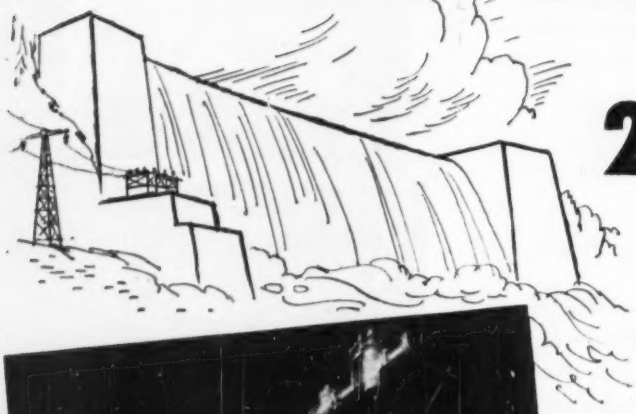
186,072,500 pounds of Tube-Ice used in building 2 WESTERN DAMS*



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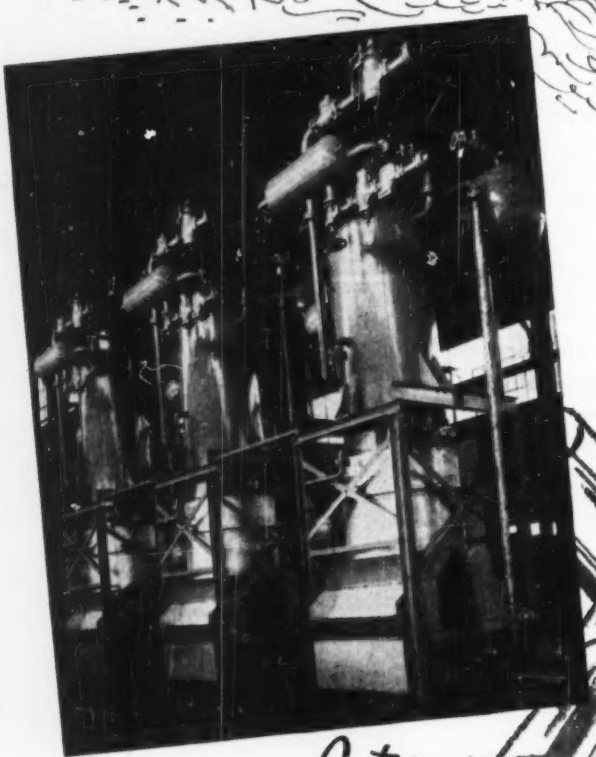

**McNary Dam, Washington, and Pine Flats Dam, California, required a total of 2,730,000 cu. yds. of ice cooled concrete mix.*

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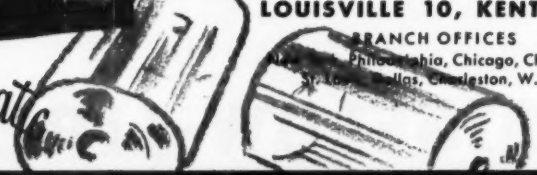

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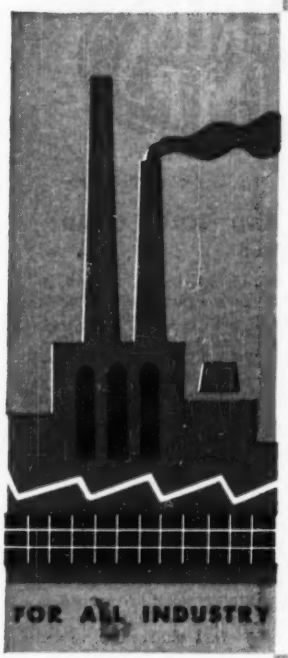

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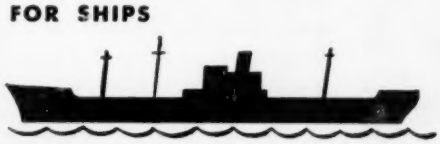

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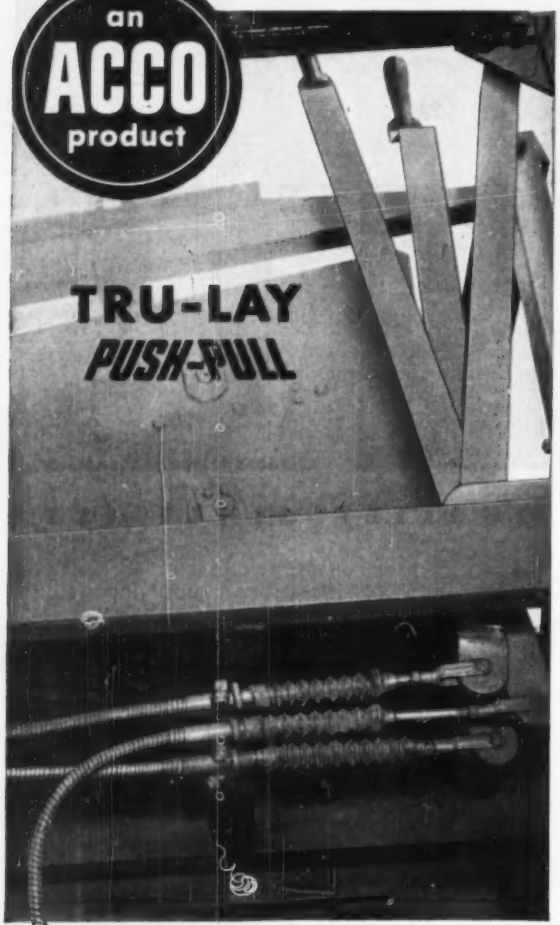

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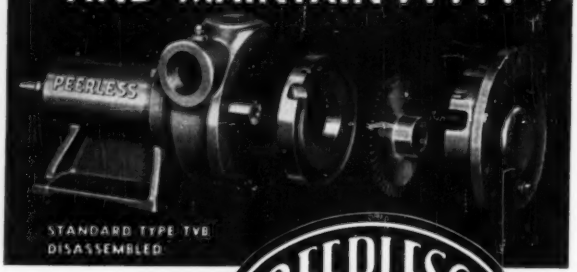

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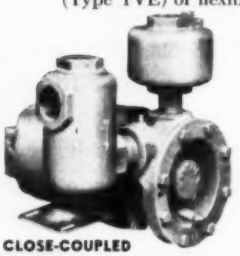

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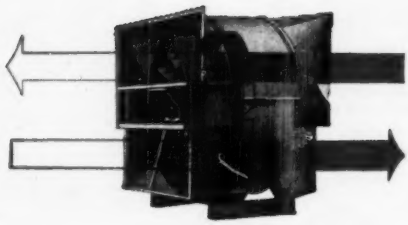
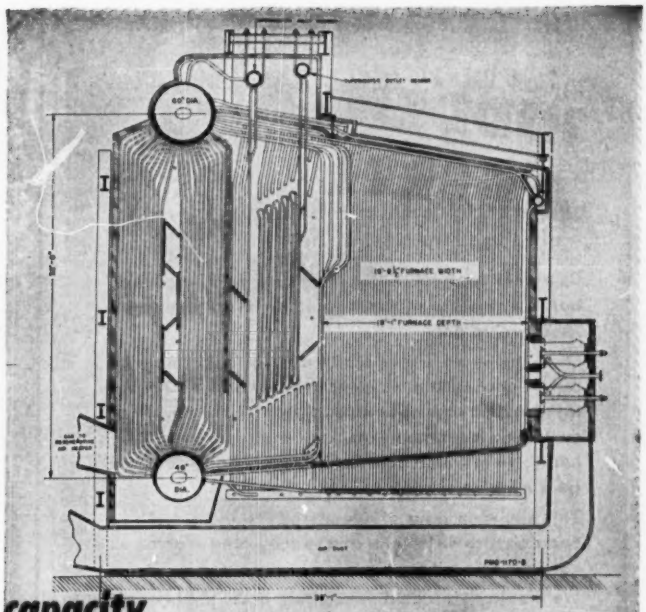




3,375,000 pounds of steam capacity at Kaiser Aluminum & Chemical Corporation

equipped with

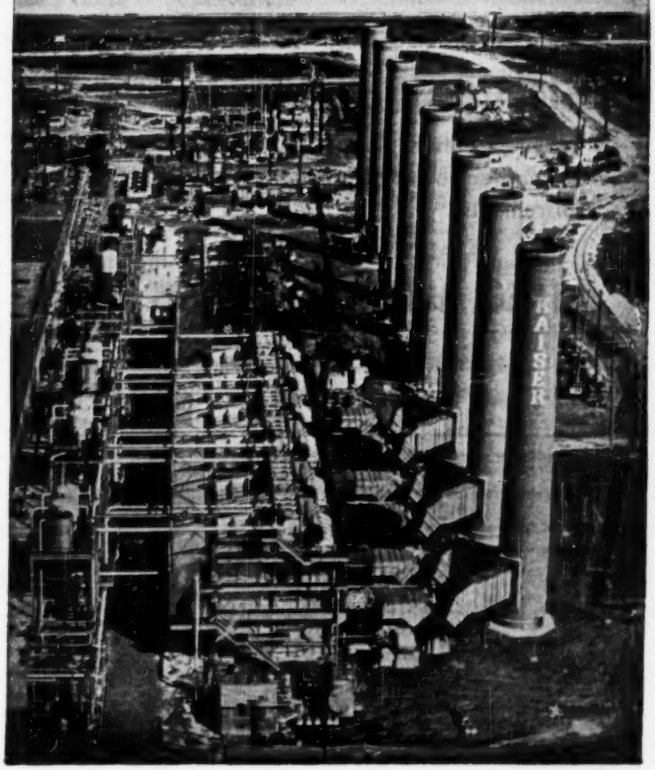
LJUNGSTROM AIR PREHEATERS

Four hundred million pounds of aluminum annually will be produced at the new Kaiser Aluminum & Chemical Corporation plant at Chalmette, La., when it is operating at full capacity. Designed and built by Kaiser Engineers, Division of Henry J. Kaiser Company, this plant will help meet the ever growing demand for aluminum products, both civilian and military.

Because it takes roughly 10 kwh of electricity to produce one pound of aluminum, the electrical generating capacity at this large new plant must be enormous. Therefore, when the plant is completed, it will have a total capacity of nearly 500,000 kw, of which 375,000 kw will be steam-generated.

The plant's vast steam requirements are met by fifteen Foster Wheeler steam generators, each with a maximum continuous capacity of 225,000 lb of steam per hr at 900 psi and 905 F. Each boiler incorporates a Ljungstrom Air Preheater, which cools exit gas to 320 F, and preheats incoming combustion air to 540 F.

The Ljungstrom Air Preheater—chosen again and again where steam generation must be efficient—can serve you, too. Its wide acceptance by utilities . . . by consultants . . . by industrial plants all over the world is your assurance that the Ljungstrom is truly the most economical heating surface on the modern boiler.



THE Air Preheater Corporation 60 East 42nd St., New York 17, N. Y.

HIDDEN ASSET!

Customer confidence doesn't show on our ledgers, but we think it's just about the most important asset we've got.

Over the years we've made a lot of old customers out of new customers simply by giving each customer exactly the right kind of gear for his job. These customers continually express their confidence by letting us assume complete responsibility for their gear problems.

This situation pays dividends all around. It enables customers to save time and money, and it gives us considerable repeat business.

We'll enjoy your confidence, too, and you'll benefit in the bargain! THE EARLE GEAR & MACHINE COMPANY, 4707 Stanton Ave., Philadelphia 44, Pa.

It's good business to do business with EARLE!

EARLE GEARS

RUGGED INDUSTRIAL HEATERS

CAPACITY FROM 300,000 to 7,500,000 B.T.U. per hour

- Maximum four pass heat transfer surface.
- Separate induced draft fan.
- Easy accessibility to accessories.
- Popular parts easily obtained anywhere.
- Heavy construction, free from vibration.
- Dust tight, damp proof control panel box.
- Flexibility for special adaptions.
- Low initial cost.

Olson

DIRECT FIRED HEATERS
Gas, Oil, Coal or Dual Gas and Oil

ARTHUR A. OLSON & COMPANY
BROAD STREET, CANFIELD, OHIO

Stainless Precision Tools

Stainless Steel T-Squares, Triangles, Straightedges, and Precision Drawing Instruments.

CATALOG ON REQUEST

THEO. ALTENEDER & SONS

Since 1850

1223 SPRING GARDEN STREET
PHILADELPHIA 23, PA.

MECHANICAL ENGINEERING

November, 1953 CARD INDEX Vol. 75, No. 11

Trend Toward Automation in Automatic Weighing and Bulk Materials Handling, I. H. Richardson 865
Machining Integrally Stiffened Structures, J. C. Borger 871
When Should a Paper Have Joint Authorship?, Walton Forstall, Jr., and W. F. Stokey 875
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MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.

Additional information is requested on the following advertisements in the December 1953 issue

Page No.	Name of Advertiser

Name _____ Title _____

Company _____

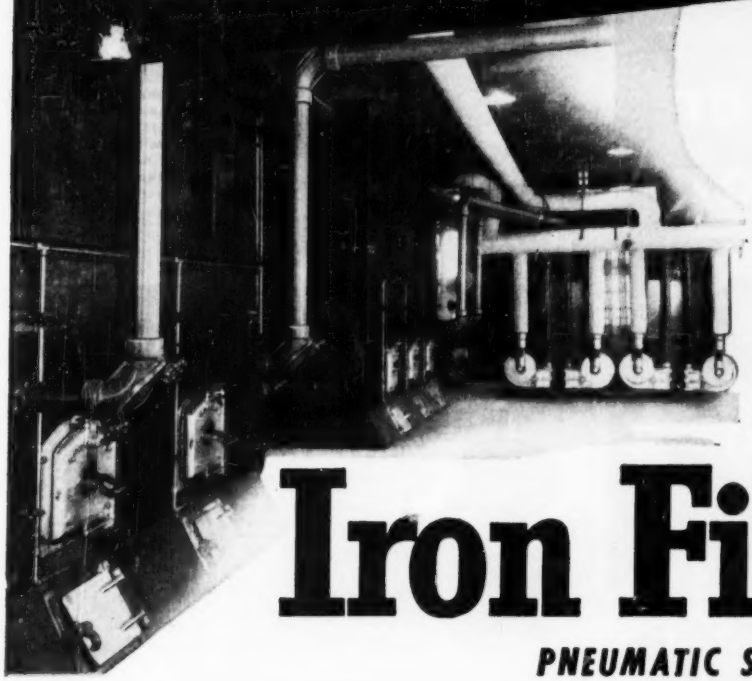
Address _____

City _____ State _____

Reader Service Coupon For More Information

Go through the advertising pages and jot down the page numbers and names of advertisers about whose product you want additional information — mail the coupon to us — your request will be passed on to the advertiser promptly — you will hear directly from advertiser — saves your time in writing individual letters.

Burns either Coal or Wood Waste



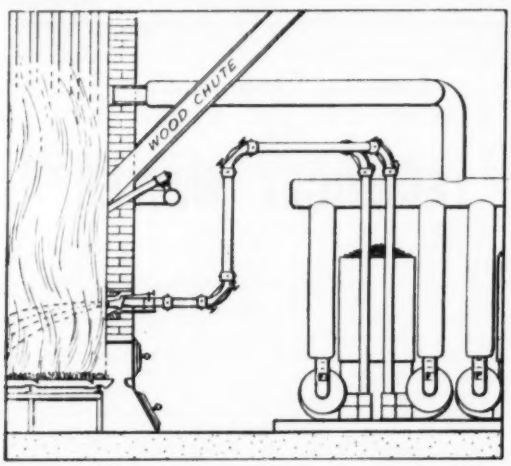
Iron Fireman coal stokers enable Bassett Furniture Industries to utilize wood refuse as fuel

These Iron Fireman Pneumatic Spreader stokers pick up the load automatically the moment the supply of wood refuse runs out. They enable the company to use wood waste as a primary fuel. Only enough stoker coal is burned to maintain a uniform steam supply.

Iron Fireman automatic air control and exclusive air-cooled grates give top firing efficiency with both fuels. Stokers are installed in six boilers, each with a capacity of 40,000 lbs. of steam per hour, which carry the power load for the various Bassett factories.

Iron Fireman

PNEUMATIC SPREADER COAL STOKERS



Coal is thoroughly dried and preheated before it is conveyed pneumatically to furnace grates. The distributor nozzle spreads the dry coal over the *entire* grate in a shallow, uniform fuel bed. Preheated fines burn in suspension, reducing cinder carryover and greatly improving combustion efficiency and responsiveness as compared with stokers which do not preheat coal. Wood waste is fed through chute at upper right.

You save three ways when you install an Iron Fireman Pneumatic Spreader stoker. You save on installation costs, you save on labor costs, and you save on fuel costs. This outstanding coal firing system dries, preheats, conveys and fires the coal. Manual coal handling is completely eliminated. Coal is piped directly from bunker to fire, doing away with the costly coal handling equipment usually required.

The Iron Fireman Pneumatic Spreader stoker burns a wide range of coals, including low ash fusion, sub-bituminous and lignite—ranging from one fourth inch slack to two inch top size. Readily adaptable to any boiler room layout. Capacities available to 1,000 boiler horsepower in single units; multiple units for larger capacities.

Dual and Triple Fuel Firing

While Iron Fireman stokers are often used in conjunction with the firing of wood waste, they are also readily combined with Iron Fireman oil and gas burners. The ability to shift fuels quickly will protect your plant against fuel shortages and permit advantageous buying of fuel. Send for descriptive literature.

Coal, Gas, Oil firing equipment for heating, processing, power

IRON FIREMAN MANUFACTURING COMPANY
3064 West 106th Street, Cleveland 11, Ohio.
Send me literature on the Iron Fireman Spreader Stoker.

Name _____

Address _____

City _____ State _____

Smooth... Power Transmission

LOVEJOY
FLEXIBLE COUPLINGS

MODERN DESIGNers specify *Lovejoy Flexible Couplings* because they offer the best obtainable insurance against alignment troubles—dampen and absorb starting torque, vibration and shock of intermittent loads . . . protect motor and driven machine . . . lengthen bearing life. *Lovejoy Flexible Couplings* are rugged in construction, provide excellent resiliency. Bodies are carefully machined. Cushions are available in materials suited to the particular load conditions . . . can be changed without shutdown. No lubrication is needed.

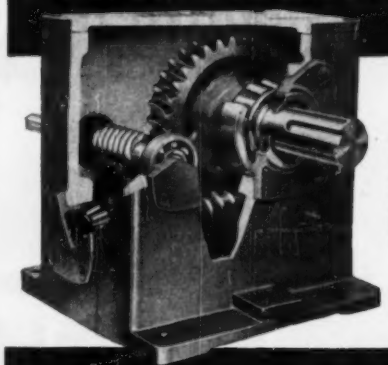
WRITE TODAY FOR FREE ILLUSTRATED CATALOG WITH ← HANDY SELECTOR CHARTS.

Also Mfrs. of Lovejoy Universal Joints and Lovejoy Variable Speed Pulleys

LOVEJOY FLEXIBLE COUPLING CO.

5032 W. Lake Street — Chicago 44, Illinois

POWER TRANSMISSION



Illustrated above is a cut-away view of Ohio Gear's D drive, showing engineering and sturdiness of the reduction unit.

TO YOUR SPECIFICATIONS OR "OFF THE SHELF"

OHIO
GEARS • REDUCERS

Ohio Gear's growing reputation has been built with the concern and future of your product in mind. Ohio Gear is constantly adapting new methods . . . adding new and modern equipment for gear and reducer manufacturing . . . all this, to improve and insure your product for longer life and trouble-free efficiency.

Ohio Gear engineers are qualified to make expert recommendations . . . write us or see our nearest distributor.

THE OHIO GEAR CO., 1360 EAST 179th STREET • CLEVELAND 10, OHIO

Unusual Opportunity for

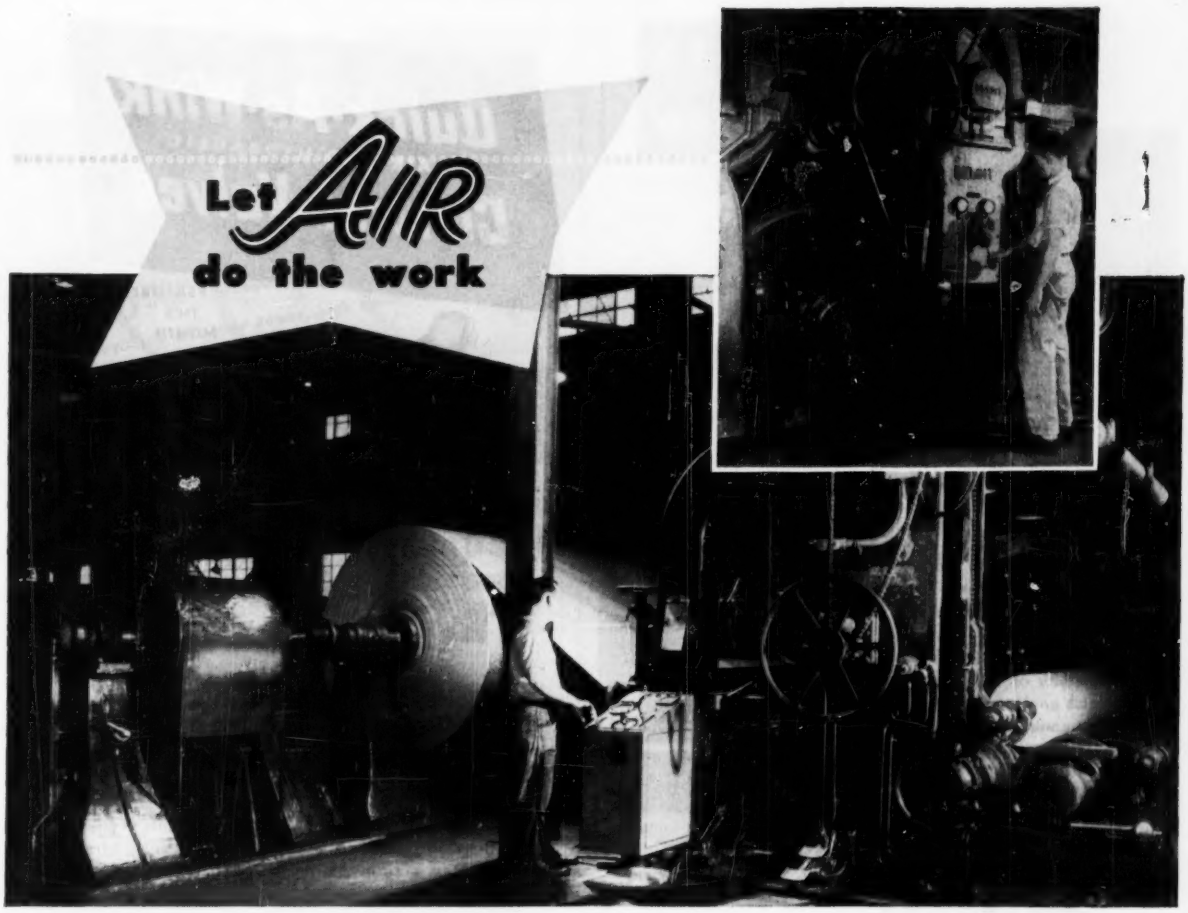
TECHNICAL WRITER

As a leading manufacturer of a line of cost-cutting industrial equipment in the fast growing oil hydraulic industry, we employ a large staff of high caliber research and design engineers. Their prolific, marketable developments create the need for an addition to our executive staff—an engineering-trained technical writer for interpreting their work for the guidance of our sales training, advertising, promotion and public relation departments. At our present pace of growth the position will become increasingly vital to our over-all operation and calls for a man of executive potential as well as one who is primarily an accurate writer on all branches of electrical, mechanical and hydraulic engineering.

We'd prefer a relatively young man who is an engineering college graduate but who has had at least a short ability-proving stint in a technical writing job—perhaps as an editorial assistant on a technical publication or an assistant editor who may be a little impatient on his editorship advancement in the foreseeable future.

In addition to receiving an attractive salary, the man we select will participate in the various employee benefits such as insurance program, pension plan and other phases of company employee relationships th .t are responsible for the long-service records of our employees and executives.

We're located in a key midwestern industrial center that offers splendid living, educational and cultural advantages. If you feel you'd like to discuss this opening with us, write fully about yourself, enclosing a photo—and you can do so with assurance that your letter will be held in strict confidence. Address CA-4539, Mechanical Engineering, 29 West 39th Street, 18, N. Y.



On one of the world's largest paper machines...

WESTINGHOUSE PNEUMATIC CONTROLS

provide *smooth* starting and stopping

THE big Macon, Ga. paper mill of Macon Kraft Co. is equipped with one of the largest Fourdrinier-type paper machines in the world. This machine operates at linear speeds from 850 to 1550 ft. per minute and has a daily capacity of 550 tons of heavy krafts and liner boards. Westinghouse Air Brake pneumatic control valves are used on this machine wherever gradual, smooth stopping and starting are required.

The entire Fourdrinier wire section, the 102 10-ton dryer rolls, and the rewinder splitter that handles rolls of paper weighing up to 14 tons, are all controlled with Westinghouse valves. The accurate, cushioned control provided by these valves reduces starting and stopping shocks imposed on the big power transmission units . . . cuts down maintenance and repairs . . . and increases the useful life of this expensive machine. As new valves are needed in other sections of the machine, Macon Kraft Co. plans to install more Westinghouse valves where closely controlled pressures are required.

FREE TECHNICAL ASSISTANCE

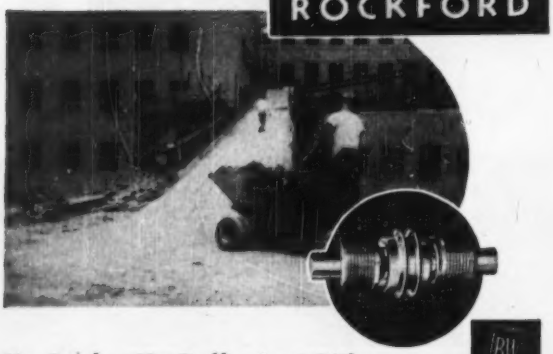
We can help *you* design a complete control system to provide more automatic operation, reduce operator fatigue, cut down wear and tear on your machine . . . all at relatively low cost. Our control and reducing valves, cylinders, actuators, checks, cocks, and other devices assure you years of *reliable* operation. For complete information write to Westinghouse Air Brake Co., Industrial Products Division, Wilmerding, Pa.

Westinghouse Air Brake COMPANY

INDUSTRIAL PRODUCTS DIVISION **WILMERDING, PENNSYLVANIA**

FACTORY BRANCH: EMERYVILLE, CALIF. **IN CANADA: CANADIAN WESTINGHOUSE CO., LTD., HAMILTON, ONTARIO**

CLUTCHES
by
ROCKFORD



No Push—No Pull—Just Ride
This Motorized Wheelbarrow

The forward and reverse, controlled dump, and direct steering features of Koerhing Company's MOTO-BUG take the hard work and high cost out of material handling for construction and industry. ROCKFORD CLUTCHES contribute to the versatility of this handy unit. Let ROCKFORD clutch engineers help plan efficient power transmission controls for your machines.

ROCKFORD CLUTCH DIVISION BORG-WARNER
1307 Eighteenth Avenue, Rockford, Illinois, U. S. A.

Engineers

AN INVITATION TO YOU TO GO PLACES WITH FAIRCHILD

Robert D. Gilson, Chief of Structures. Has worked on many top aviation projects in the aircraft industry, specializing in structural problems.

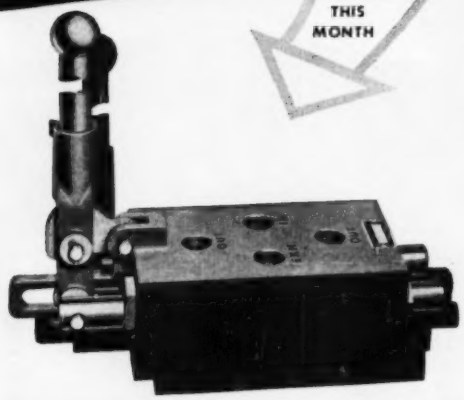
A secure future, exceptional opportunities for advancement, and a high starting salary await you at FAIRCHILD. We have openings right now for qualified engineers and designers in all phases of aircraft manufacturing.

Paid vacations, liberal health and life insurance coverage. Premium is paid when longer work week is scheduled.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD *Aircraft Division*
HAGERSTOWN, MARYLAND

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves

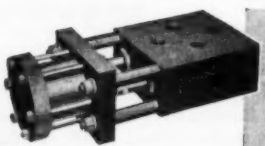
FEATURE THIS MONTH



Lever Operated Hydraulic Valves
For line pressures up to 5000 psi

● Unsurpassed for efficient trouble-free service controlling single or double acting hydraulic cylinders and other important high pressure hydraulic circuits. Positive, fast acting. All parts are in pressure balance, eliminating any tendency to creep or crawl. Machined steel housings, with chrome plated and polished stainless steel plungers. Self sealing U-packers. Metal valving rings take the impingement of the liquid, minimizing wear on the packings. ½" to 1½" sizes. Also available in pilot operated designs; sizes to 4". Write for details.

also the following



PILOT CYLINDER OPERATED HYDRAULIC VALVES

Two position valves 1½" to 4" sizes for line pressures from 1000 to 5000 psi. Valve is placed close to the work and operated from a central control point with an easy to handle air valve avoiding operator fatigue.

SOLENOID OPERATED AIR VALVES

Widely used for controlling single and double acting air cylinders, clutch and brake controls, etc. Solenoid is directly connected to valve operating mechanisms. ⅜" to 1½" sizes. 2-way, 3-way and 4-way actions.

For Fully Descriptive Data Sheets Write

C. B. HUNT & SON, Inc.

Hand, Foot, Lever, Cam, Pilot, Diaphragm and Solenoid Control Valves

1953 EAST PERSHING STREET • SALEM, OHIO

AIR • GAS • AMMONIA / compressor operators

DID YOU KNOW...

you can build peak performance into your oldest compressors!

and obviously into your newer, high speed machines, too!

INSTALLATION OF VOSS VALVES WILL DO THE JOB!

if you want peak performance . . . increased efficiency . . . greater output . . . lower power costs with utmost safety, investigate the advantages of VOSS VALVES for your machines.

VOSS VALVES provide. . . Quiet, vibration-free operation • 20 to 60% more valve area • less power consumption • low pressure loss • normal discharge temperature • lower operating costs • utmost safety.

To increase the efficiency of your compressor, send us the name, bore, stroke and speed of your machine. Our detailed proposal will be sent without obligation.

VOSS VALVES REG. U.S. PAT. OFF.

J. H. H. VOSS CO. INCORPORATED

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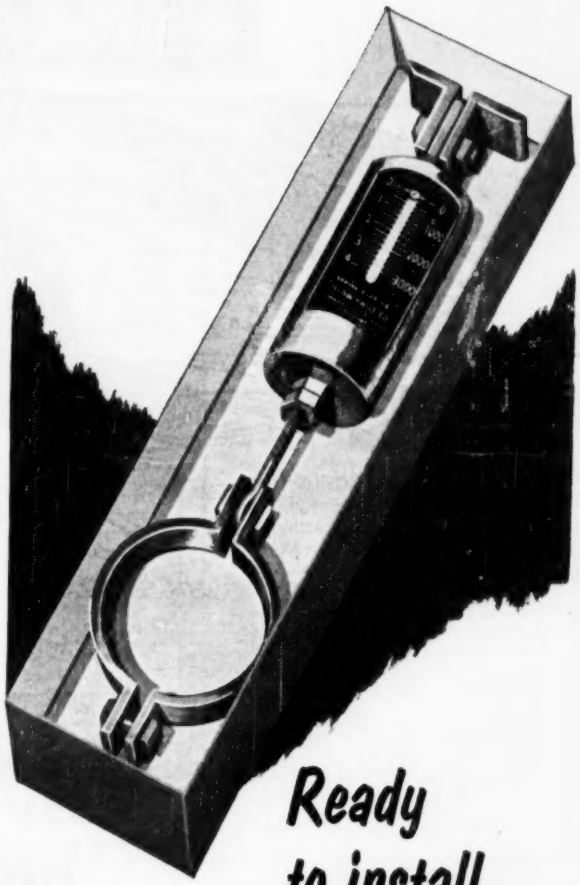
THE Finest TRACING CLOTH

Imperial is known in drafting rooms all over the world as the traditional quality tracing cloth.

With the background of decades of experience, its makers have pioneered in modern improvements to maintain Imperial as the finest tracing cloth made.



Ready to install as received

For any piping installation in which flexibility is important

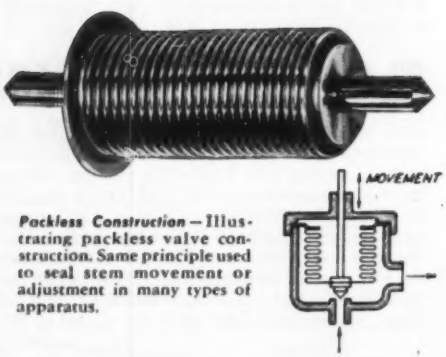
BLAW-KNOX HANGERS

with patented Internal Swivel Action are "made-to-order." Each is a complete packaged unit . . . saving you expensive cutting, threading and assembling in the field. Other supports developed by Blaw-Knox Power Piping engineers include Overhead Roller Assemblies, Rigid Hanger Assemblies and Vibration Eliminators for any piping requirement. If you want data that will speed your specifications and cut your engineering time send for Catalog #51.

BLAW-KNOX COMPANY
POWER PIPING AND SPRINKLER DIVISION
PITTSBURGH 33, PA. • CEdar 1-0700

BLAW-KNOX

A SPECIALIST DOES IT BEST!



Packless Construction — Illustrating packless valve construction. Same principle used to seal stem movement or adjustment in many types of apparatus.

● If your products or product plans require bellows assemblies, you can get real help from specialists at Fulton Sylphon or Bridgeport Thermostat. They've specialized in this field for over half-a-century.

This valuable experience can help you in many ways. Skilled personnel and ample production facilities are ready to take care of your bellows assemblies needs quickly and accurately.

And our specialists are equally helpful in working with you to design and produce bellows assemblies specifically adapted to your requirements. On all counts you save time, production worries and expense.

Sylphon and Bridgeport bellows assemblies are used in many ways—as flexible connectors, for thermostatic devices, pressure controls, hydraulic mechanisms, expansion joints and other units. Wide range of metals and sizes. Write for information. Ask for helpful, idea-filled Catalog XK-1400.

FULTON SYLPHON
DIVISION
Knoxville 1, Tenn.

Robertshaw-Fulton
CONTROLS COMPANY
EVERYTHING'S UNDER CONTROL

TEMPERATURE CONTROLS · BELLOWS ASSEMBLIES · BELLOWS DEVICES

BRIDGEPORT THERMOSTAT
DIVISION
Bridgeport 1, Conn.

Representatives—Sales Agencies
Business for Sale
Partnership—Capital
Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

ENGINEERS & DRAFTSMEN

Progressive, well-known manufacturer of machine tools needs engineers and draftsmen for expanding machine and equipment design program. Company offers pleasant working conditions, stable employment and advancement opportunities. Location is in a pleasant Vermont town with all modern facilities. Send resumé of personal and educational background and experience to

Philip C. Durland
BRYANT CHUCKING GRINDER COMPANY
Springfield, Vermont

SALES ENGINEER

To represent nationally known fabricator of pressure and process piping; cover Eastern Michigan, Indiana, Ohio, West Virginia, and Western Pennsylvania; salary and expense account; engineering background or experience in industrial piping required; send full information and salary expected.

Address CA-4530, % "Mechanical Engineering."

ENGINEER

Excellent opportunity in PRODUCT DEVELOPMENT in instrument manufacture (flows, pressures, vacuums) for a man (30–45) well grounded in mechanical and electrical engineering and with a working knowledge of electronics. Applicant should have creative engineering ability and be capable of advancing into administrative work. Write J. B. Meriam, Jr., President, The Meriam Instrument Company, Cleveland 2, Ohio, giving education, experience, age, other qualifications and salary expected.

PRODUCT DEVELOPMENT ENGINEER

Major Ohio tire manufacturer seeking outstanding engineer with definite interest in development work. Prefer young aggressive graduate with three to five years' industrial experience. Applicant desired should have creative ability and capable of carrying project work to completion. This position offers qualified man exceptional opportunities. In reply state age, education, experience and salary expected.

Address CA-4535, % "Mechanical Engineering."

ENGINEERS DESIGNERS SPECIALISTS

Prefer men with several years' experience. Assignments involve design of power plants, advanced test facilities, and general industrial facilities. Desire adequate background in any of these fields.

- **Aerodynamic design of advanced test facilities and associated equipment.**
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- **Process controls design. Valves.**

Sverdrup & Parcel, Inc. was established in 1928 and employs over 500 people. Over 150 hold professional registration. Unusual engineering opportunities exist with our well established firm in connection with the design of a variety of engineering projects. Included are advanced test facilities, bridges, buildings, power plants, and general industrial installations.

Please write fully to—

SVERDRUP & PARCEL, INC.
Consulting Engineers
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Mechanical engineers needed for research and development programs. Organization undergoing expansion and needs several additions to staff. Retirement program, etc.

Foundation for Industrial Research
University of Wichita
Witchita, Kansas

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for design of special medium weight automatic equipment. Will be called upon to experiment with and recommend improvements to existing equipment as well as design of new equipment. Degree in mechanical engineering desirable. Should have a minimum of five years of design experience. Location: Chicago Compensation dependent upon experience and ability. Position is not dependent on defense contracts and is permanent and offers good working conditions with excellent company benefits. Replies will be treated confidential and arrangements will be made to interview selected applicants. Submit complete resumé stating experience, education, salary required and date available.

Address CA-4529, % "Mechanical Engineering."

SUPERVISOR OF MAINTENANCE

$495 to $599 per month

Experience in Building Construction and Maintenance including Supervision of Several Major Building Crafts

Knowledge of Cost Estimating, and Specification Writing

Vacation—Sick Leave—Retirement

For further information write

Pasadena City Schools
Division of Personnel Services
351 South Hudson Avenue
Pasadena 5, California

READ the* CLASSIFIED ADVERTISEMENTS *appearing in this section each month.

DEVELOPMENT ENGINEER

Some graduate study preferred and 6–8 years' experience in petroleum, chemical, power or allied fields of plant design.

Permanent position on the East Coast with an organization known throughout the world for important contributions to the oil and chemical industries for a graduate ME or ChE.

High salary and excellent opportunity to advance as our organization continues to grow. Other employee benefits such as insurance and pension plans are unusually generous.

Please reply giving initial salary requirements and include information on education, background, experience and initial salary desired. Traveling and moving expenses will be paid.

Box 131, Room 1201
230 West 41 St., New York 36, N. Y.

TECHNICAL PERSONNEL

looking for opportunities in

ATOMIC ENERGY

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- MACHINE DESIGN
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- CHEMICAL ENGINEERING DESIGN, RESEARCH, AND DEVELOPMENT

MATHEMATICIANS AND STATISTICIANS

- ENGINEERING OR PHYSICAL SCIENCE BACKGROUND DESIRABLE

METALLURGISTS

- PHYSICAL AND PROCESS

Qualified graduates with 0–8 years' experience
Send resumé and salary information to
TECHNICAL PERSONNEL OFFICE

CARBIDE AND CARBON CHEMICALS COMPANY
a division of
UNION CARBIDE AND CARBON CORPORATION
POST OFFICE BOX P, OAK RIDGE, TENNESSEE

Mechanical Engineer and Designer

with several years' experience. To design heavy rotating equipment, such as forced draft fans and other high pressure axial flow blowers. Salary open, permanent position. Send resumé and recent photo to:

PERSONNEL MANAGER
JOY MANUFACTURING COMPANY
NEW PHILA., OHIO

Additional Opportunities are offered in the display advertisements—on pages
47, 52, 54, 55, 58, 124, 126

MECHANICAL ENGINEER

Recognized, established industrial operation in St. Louis is seeking a Mechanical Engineer. Assignments will be diversified in plant layout, determining structural working loads, planning new facilities, specifying new equipment, and associated duties. We are in a position to use a recent graduate or one who has Mechanical Engineering experience. Immediate and long time opportunity of unusual nature. Prefer engineering graduate. Salary most appropriate. This is an opportunity well worth investigating. Replies held in confidence.

Address CA-4534, % "Mechanical Engineering."

SENIOR MECHANISM DESIGN ENGINEER

Prefer man with 10 to 15 years' experience. Must have excellent knowledge of designing for production. Experience with gears, bearings, seals and hydraulics will be helpful. Work will be on petroleum industry mechanisms.

Write or call:

General Manager
Borg-Warner Corp., Petro-Mechanics Research Div.
10659 Burbank Boulevard
North Hollywood, California

SALES ENGINEER

Age 25 to 35. M.E. degree. To handle sales correspondence, prepare sales literature. Later to handle specific outside sales assignments including training of manufacturers representatives personnel, sales engineering and service complaints. Experience in steam and hydraulic specialties desirable. Home office and plant in Chicago suburb. A permanent position with real opportunity for growth. Send complete resumé and compensation requirement. Recent photo if available.

Address CA-4522, % "Mechanical Engineering."

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"OPPORTUNITIES" Section This Month 129-131

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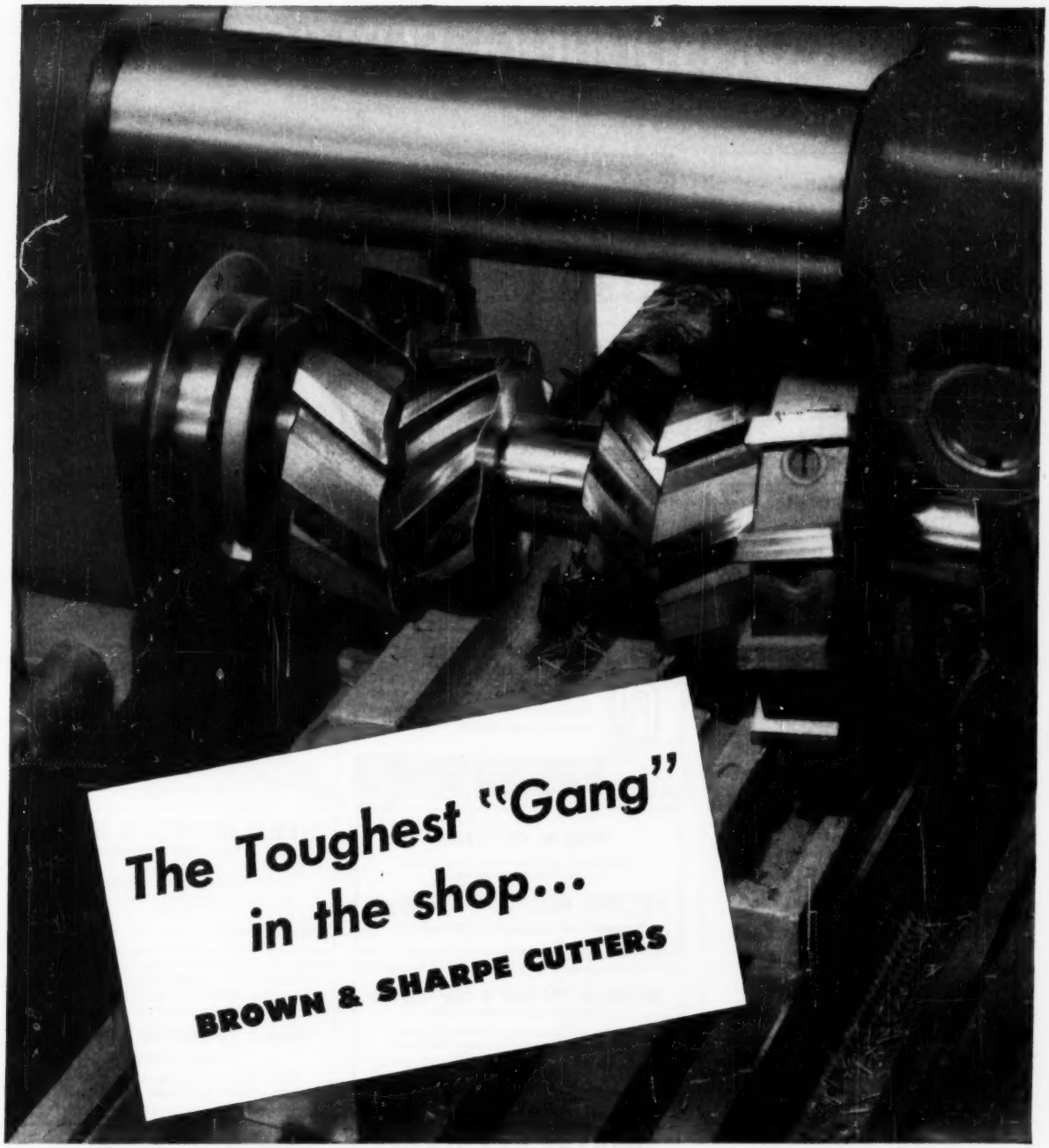

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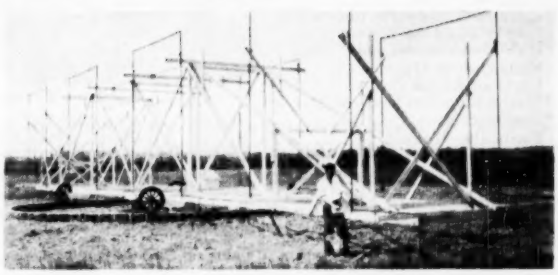

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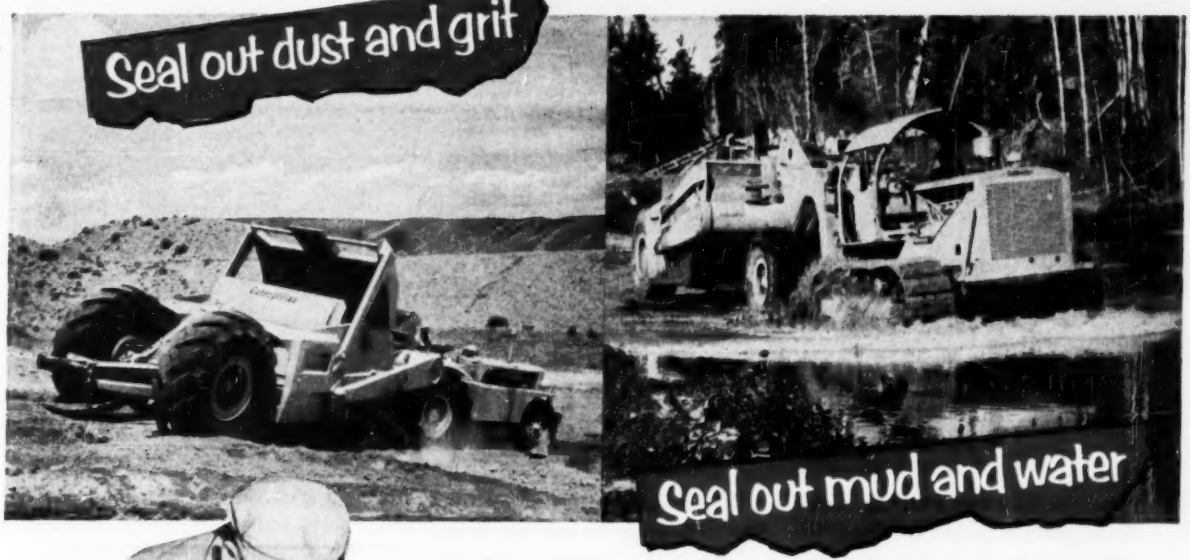

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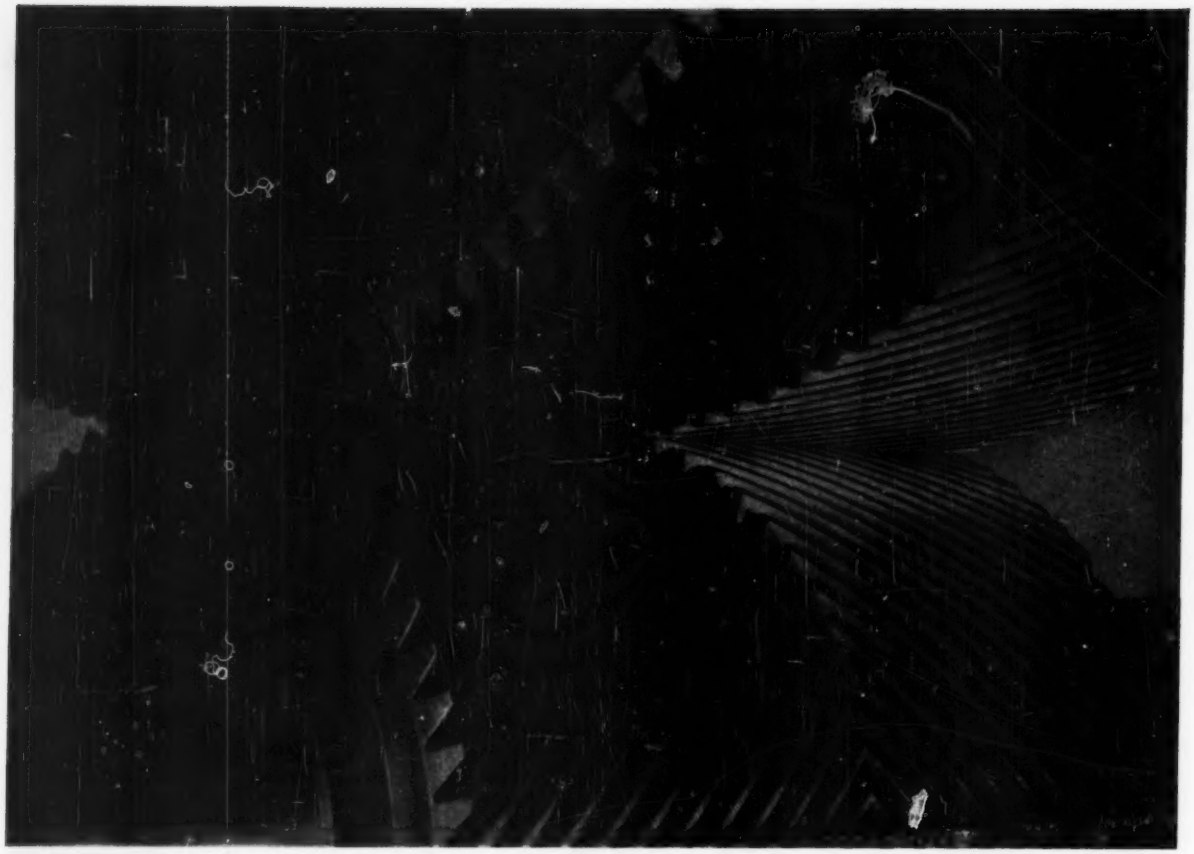
SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Dallas, San Francisco, Los Angeles, Portland, Seattle, San Diego, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.



These gears INHERIT precision

The precision in Farrel® herringbone gears is passed on from the machine on which the gears are made — the Farrel-Sykes Gear Generator.

The accuracy inherent in the operating principle of the machine—"*precision generation*"—gives the gears extremely accurate tooth spacing, profile and helix angle. Because of this, you can be sure that Farrel herringbone gears will operate smoothly, quietly and efficiently over a long service life.

These precision-generated gears are made in any size from ¼" to 20' 0" diameter, for any power capacity and speed. Also available are straight tooth and single helical gears in sizes up to 20 feet diameter, and large internal gears with either spur or helical teeth.

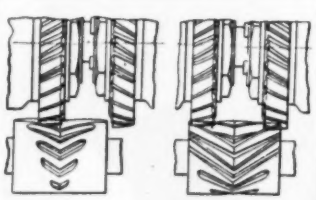
Farrel engineers will be glad to assist you in working out unusual gear problems. Write for further information about any of the types of high-precision gears mentioned above.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Akron, Detroit, Chicago, Memphis, Minneapolis, Portland (Oregon), Los Angeles, Salt Lake City, Tulsa, Houston, New Orleans

Farrel-Birmingham®

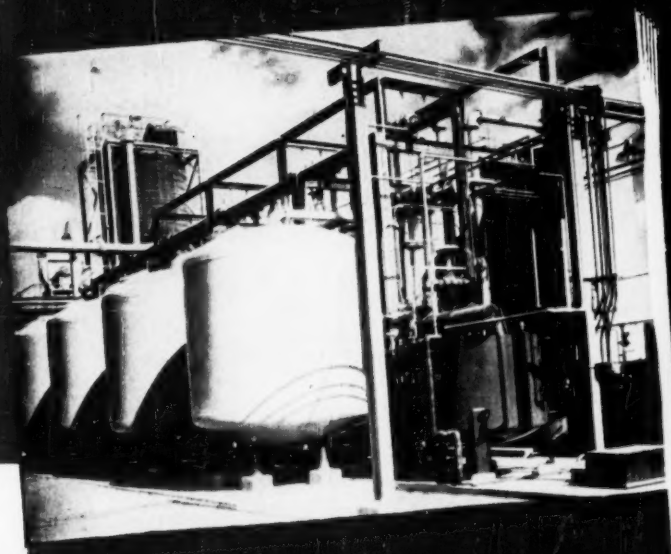
FB-863



PRECISION GENERATION

The Farrel-Sykes gear generator is a gear-shaping machine having two cutters, mounted on a single reciprocating carriage, with their cutting faces opposed.

The cutters reciprocate, one cutting when movement is in one direction and the other when the movement is reversed. Each ends its stroke at the center of the blank. As they cut they twist to generate the helices and also slowly revolve in unison with the gear blank to generate the tooth contours precisely.



DEMINERALIZATION
including SILICA REMOVAL
by **PERMUTIT**
ION EXCHANGE

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. . . about Permutit Demineralizers for Purer Make-up . . . Lower Cost

You'll want this interesting booklet! Flow diagrams, illustrations and specifications explain key methods of demineralization and silica removal by Permutit ion exchangers and equipment. Write for your free copy —today!

HIGHEST PURITY MAKE-UP Effluents of Permutit Demineralizers have contained *total* electrolytes as low as 0.01 ppm, and silica as low as 0.01 ppm. Under service conditions, values may be slightly higher. In comparison, most distilled water contains 20 to 100 times more electrolytes . . . yet costs much more to produce.

REDUCES B.T.U. COST PER KW-HR The chemical cost for demineralization is usually less than the fuel cost for evaporation of boiler feed make-up. The installed equipment cost for demineralization is also usually less than for evaporation.

ELIMINATES CONDENSATE SHORTAGES A demineralizer is operated independently of the turbine. It may be operated at full capacity if required, even though the turbine is running light and some boilers are standing by idle. It is possible to start boilers of a new plant with demineralized water. The demineralizing system can be placed in operation ahead of the boilers and highest purity make-up prepared for initial starting.

ION EXCHANGERS MEET ALL REQUIREMENTS Choice of units and layout of demineralization and silica removal equipment depend on composition of the water, flow rates, end-use requirements. Permutit makes all types of ion exchange resins and equipment . . . can save you time and money in the specification of the one combination that best fills your needs.

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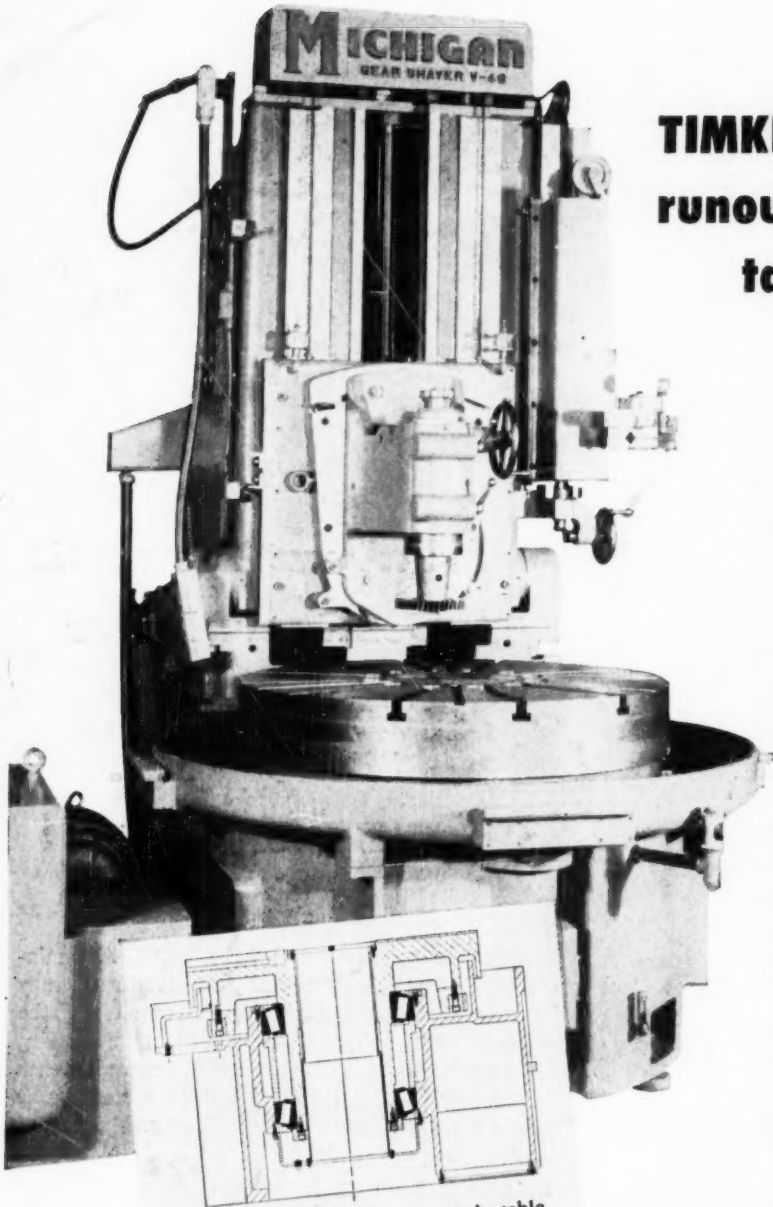


How **MICHIGAN TOOL CO.** mounts the table spindle of its Model V-48 Gear Shaver on Timken tapered roller bearings to insure high precision, trouble-free performance.

TIMKEN® bearings hold runout on gear shaver table to .0002"

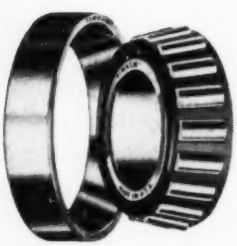
TO maintain the high precision necessary in gear shaving operations, Michigan Tool Co. mounted the table spindle of its Model V-48 Gear Shaver on Timken® precision tapered roller bearings. At General Electric's turbine plant in Lynn, Massachusetts, a measurement of the gear shaver's accuracy showed a maximum runout of .0002", exceptional in view of the fact that the bearings involved have 17⅛" and 16⅛" bores.

Made specifically for spindle applications, these Timken bearings assure highest precision because of (1) bearing accuracy and (2) shaft rigidity maintained by line contact between rollers and races. And the tapered construction of Timken bearings eliminates end-play by taking any combination of radial and thrust loads. Result: gears are shaved more accurately.

True rolling motion and smooth surface finish make Timken bearings practically friction-free. Made of Timken fine alloy steel, Timken bearings normally last the life of the machine in which they're used.

Be sure to specify Timken bearings in the machinery you build or buy. Look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

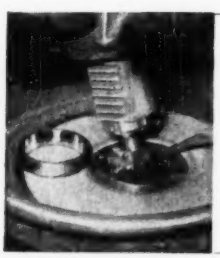
This symbol on a product means its bearings are the best.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ↕ AND THRUST →↓← LOADS OR ANY COMBINATION →✳←